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ORIGINAL ARTICLES

DIMENSIONS VERSUS FORM IN TEETH AND THEIR BEARING ON THE MORPHOLOGY OF THE DENTAL ARCH*

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> "We biologists can not too frequently and too emphatically deplore the mathematical mania through which men of considerable ability have been misled to pose as defenders of an erroneous conception. This mania is that no science is accurate until its results can be mathematically expressed." (Minot.)[1]

IN the advancement of new ideas bearing upon the more intricate problems associated with processes of life, there is often evinced a tendency of obscuring the real purpose by misleading representations and confusing deductions. The desire of demonstrating their self-importance and originality, often prompts some conscientious and capable workers to resort to exaggerations that not only tend to overbalance the point of benefit to be derived by their labors, but also create a disposition of antagonism that frequently leads to a rejection of the principles involved.

In orthodontia no less than in other fields of scientific work, original methods of procedure pertaining to the correction of occlusal anomalies are advanced with regular frequency. The vehemence with which they are brought forth often sets the profession aglow with ecstasy over the marvelous achievements attainable,—provided the one or the other principle, method or formula be adopted in practice. Many were the occasions within the last decade when, so-called, basic principles were propounded for the simplification of the scheme involved in treatment; but no sooner were they espoused as the *panacea for all orthodontic ills* when their doom was inevitable.

The one idea still lingering in the minds of many orthodontists, and frequently giving rise to impetuous controversies is *that the form assumed by the*

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human dental arch is dependent upon the dimensions of certain teeth constituting it. This contention in its broadest aspects is inseparable from several assumptions; namely,

1. That there is a definite relationship between the *size* of the teeth and the *form* of the dental arch.

2. That by the employment of certain methods of calculation, using the dimensions of the teeth as a basis, a formula, diagram or plan of that form of the dental arch can be obtained in a case of malocclusion which nature would have produced had no interference occurred.

3. That by following the procedure advanced, uniform success is assured in the treatment of every case of malocclusion.

4. That the propounded methods are universal in their application.

The main contention at issue, however, upon which the entire scheme is

FORMS OF DENTAL ARCHES OF ANTHROPOID APES			1	2	3	4	5	6
			 PYRIFORM	 U-SHAPED	 DIVERGENT	 O-SHAPED	 SADDLE-SHAPED	 LYRIFORM
GENERA	Gibbon	Upper		4.84	14.51	3.23	2.42	75.00
		Lower		0.83	85.83	10.83	1.67	0.83
	Orang	Upper	38.55	28.91	10.80	20.48	1.20	
		Lower	5.33	40.00	20.00		34.66	
	Gorilla	Upper	15.38	46.13	15.38		23.07	
		Lower		21.74	43.48		34.78	
	Chimpanzee	Upper	8.00	8.00	28.00	16.00		40.00
		Lower	8.33	4.16	66.66	20.83		

Fig. 1.—Diagrammatic illustrations of arch forms of the anthropoid ape dentitions and their frequency of appearance in both jaws expressed in percentage.

based, rests on the premise that there is a *definite relationship* between the *size of the teeth* and *the form of the arch.* Without attempts at an explanation or verification of the truth of such a *presumption,* it is universally proclaimed and severally accepted as *a fact* and thereupon utilized in the construction of most pretentious methods by which formulæ are obtained that are of general application in the correction of occlusal anomalies. Granting, only for the sake of argument, that the older methods of treatment were based upon error—as is usually claimed, by the promoters of the various new schemes—it devolves upon the verification of the correctness of the methods advanced whether they are justified in superseding their predecessors. Since, however, scientific evidence besides mathematical calculations, bearing upon the fundamental principles is rather meager, the entire proposition may be considered as an open question. Therefore, before accepting and putting any such theory into practice, it is justi-

fiable to take it to test and see whether its fundamental principles may be either corroborated or refuted. This is the scientific way, for science is nothing more than tested and verified truth.

Owing to the complexity in the organization of the human organism, it is difficult to single out any particular morphologic unit whose simplicity will lend itself for the purpose of investigation to determine the various phases within which it may be manifested. The range of variability of such units in man is so extensive and so gradual in its transitional aspects from one form to another as to preclude the possibility of an exhaustive examination necessary to a clear understanding required for general deductions. It is therefore of considerable advantage to confine such investigations in the study of animals exhibiting closely allied characters to those sought for in man and note their behavior under similar conditions.

The dentition in the anthropoid apes, for instance, presents many characteristics that render it similar to that in man. Except the canines, lower first premolars and some minor anatomic details, the teeth of the orang, gorilla, chimpanzee and gibbon bear morphologically and numerically a close resemblance to those in man. Physiologically, they constitute the omnivorous type, being utilized in the mastication of a variety of foodstuffs; such as fruits, vegetables, insects, and birds.

The dental arch of the anthropoid ape, though bearing less resemblance to that in man than the teeth themselves, nevertheless, presents a variety of forms, so limited in number and so easily distinguished as to lend itself very advantageously for the purpose of study. Thus, the dental arches of the anthropoid apes are found to assume the six forms illustrated in Fig. 1, which represents a diagrammatic outline of the curves in which the teeth are arranged in the jaws. For the purpose of clearness these forms are named severally: Pyriform, U-shaped, Diverging, O-shaped, Saddle-shaped, and Lyriform as noted in Fig. 1. These forms are not equally distributed among the various genera, neither do the dentitions of all the individuals of each genus assume the same arch forms.

Thus, the dental arch form of the orang, for instance, may be classified in accordance with the following outlines:

1. The Pear-shaped (Pyriform) arch;
2. The U-shaped arch;
3. The Diverging arch;
4. The O-shaped arch;
5. The Saddle-shaped arch;
6. None of the Lyriform type.

Those of the gorilla present the following forms:

1. The Pear-shaped arch;
2. The U-shaped arch;
3. The Diverging arch;
4. None of the O-shaped type;
5. The Saddle-shaped arch;
6. None of the Lyriform type.

While the arch form of the chimpanzee conforms to the following outlines:

1. The Pear-shaped arch;
2. The U-shaped arch;
3. The Diverging arch;
4. None of the O-shaped type.
5. The Saddle-shaped arch;
6. The Lyriform arch.

And the arch form of the gibbon conforms to the following outlines:

1. None of the Pear-shaped arch;
2. The U-shaped arch;
3. The Diverging arch;
4. The O-shaped arch;
5. The Saddle-shaped arch;
6. The Lyriform arch.

The frequency of appearance of these forms in the various genera may be seen expressed in percentage in the Table (Fig. 1).

With the object in view of testing first the assumption regarding the relationship of the dimensions of the teeth to the form of the arch, it is necessary, for obvious reasons, to bear in mind that if the dimensions of the teeth would yield a clue to that form of dental arch within which they will align themselves under normal conditions, then, given a series of normal arches of a certain form, the homologous teeth should be of similar sizes. Or, taking the homologous teeth of the different individuals possessing the same form of arch they must collectively have a higher average value than those of the diverse dental arches. Conversely, given the size of homologous teeth of dentitions presenting different arch forms, they should be found to present a greater dissimilarity than those found in the same arch form; or their combined size should present a lower average. The results, however, do not correspond to either of these expectations.

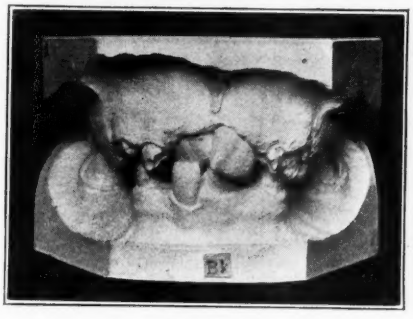
Taking the most frequently occurring form of the upper dental arch in each genus, the following application was made. The dimensions of the mesio-distal diameter of the central incisors were obtained and as the individual teeth were found to vary considerably, a comparison was made which was based on the *average* dimensions of the teeth found in homologous arches in order to determine the extent of difference from those belonging to heterologous forms. The results obtained may be summed up as follows:

The upper dental arch form appearing with greatest frequency in the gibbon is the *lyriform.* The mesio-distal diameter of the central incisors found in this arch *ranged from* 3.5 *mm. to* 6 *mm.,* while the *average was* 4.84 *mm.* The range of variation in the mesio-distal diameter of the central incisors of the same genus embracing *all* arch forms *ranged from* 3.5 *mm. to* 7 *mm.* and *averaged* 4.88 *mm.,* showing a difference of 0.04 mm. Of course, the difference is negligible, but *there should have been a considerable increase in the average of tooth size of a uniform arch, if tooth size and arch form were correlated.*

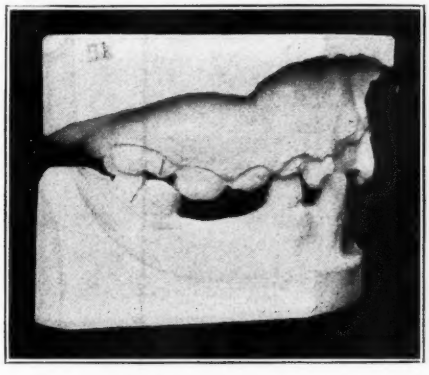
The application of this test to the other genera of the anthropoid family brought about results of a similar character.

Thus, in the orang, the arch form of the upper jaw which appears most frequently is the pyriform. The incisors which were measured in those arch

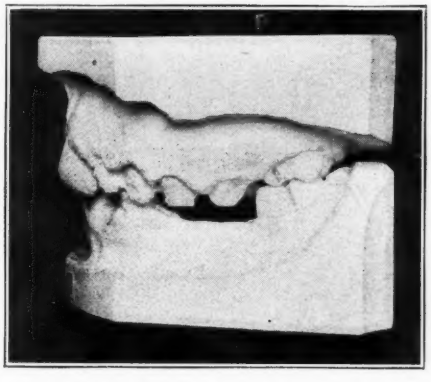
forms averaged 13.13 mm., while those of the various arch forms combined averaged 13.02 mm. In the gorilla the U-shaped arch appears with the greatest frequency in the upper jaw. The central incisors of that arch form averaged 13.13 mm. The central incisors of the combined arch forms averaged 13.14 mm. The chimpanzee has the lyriform arch in the upper in greatest frequency and the incisors therein averaged 11.62 mm., while the incisor of the combined arch forms averaged 11.31 mm.



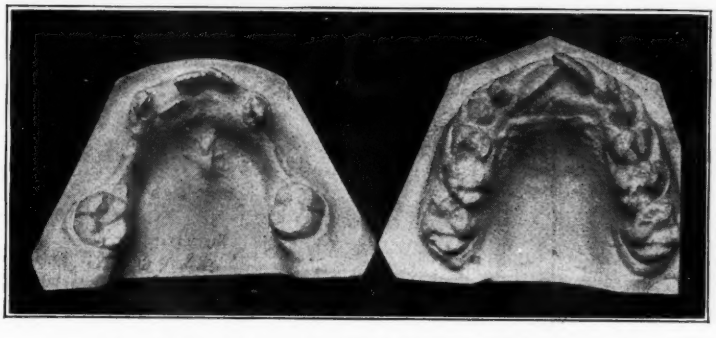
A.—Front view showing incomplete eruption of the upper central incisors.



B.—Right side view showing occlusion, missing lower and disintegrated upper deciduous teeth.



C.—Left side showing similar condition as in B.



D.—Occlusal view, showing deformed dental arches.

Fig. 2.—Case of malocclusion not infrequently met with in orthodontic practice, showing the incisors and first permanent molars as the only teeth measurable.

It is, therefore, quite plain that there is no difference, or a negligible one, in the correlation of the average mesio-distal dimensions of the incisors associated with various arch forms or of those associated with a particular form.

It was then of interest to ascertain whether there is any correlation between like dimensions of different teeth in each dentition presenting the same arch form. For, it was thought that the great variability of one tooth may be counteracted by a reverse condition of another, but their combined dimensions may bear a correlation to the form of dental arch. Therefore, given the dimensions of certain teeth of different denominations in dentitions having the same form of arch, there should be some sort of correlation between them if their size has any bearing upon arch form. This matter was subjected to the following tests: The upper central incisor and first molar of the permanent series, associated with the various arch forms, were carefully measured and their relative size noted.

It may be asked, and justly so, why, of all the teeth in the denture, were the central incisor and the first molar selected to bear the brunt of the burden? To which it may be answered that of all the baffling problems confronting the orthodontist relative to the form of the dental arch, the most perplexing ones are presented by conditions as illustrated by the case shown in Fig. 2, *A, B, C,* and *D.* And if the measuring of teeth is to be of any benefit in outlining the form of arch, its value will be inestimable if it be applicable in this type of case. It must be said at this point that this type of case is quite frequently met with in practice. Upon examination of this case, it will, at once, be apparent that of all the teeth present, the only ones measurable are the central incisors and the first permanent molars. The other teeth as may be seen are either disintegrated or entirely lost. Furthermore, if measurements be taken of the central incisors, the only reliable dimensions obtainable in this case are those of the mesio-distal diameter. The labio-lingual or the gingivo-incisal dimensions could not be obtained because of the incomplete eruption of those teeth. Of the molars, on the other hand, the bucco-lingual diameter can be more easily obtained in conjunction with the mesio-distal dimensions.

Thus, if there be any basic truth in the contention that there is a relationship between arch form and tooth dimension, there must also be a correlation in the sizes of the various teeth of each dentition conforming to the same arch outline. That is, taking the central incisors and first permanent molars of dentitions showing the same form of dental arch, they should show a correlation in size to each other. For instance, of the thirty-two orang skulls presenting the pear-shaped (pyriform) arch form in the upper jaw, the mesio-distal diameter of the central incisors showed no uniformity but varied from 9.5 mm. to 16 mm., while that of the first molar ranged from 11 mm. to 15 mm. The correlation of the dimensions of these two teeth may be seen in Fig. 3, which is a graphic representation of these combined measurements arranged in the form of curves, the horizontal lines (not visible in the illustration) indicating the measurements of the teeth in millimeters, while the vertical lines indicate the inciso-molar relation of each dentition exhibiting the same arch form.

As may be noticed, the line I which represents the mesio-distal diameter of the incisors ascends gradually, while the line M which represents the dimen-

sion of the related molars is irregular; showing *no correlation whatever* between the two. The relation between the bucco-lingual diameters of these teeth may be seen in Fig. 4 which was constructed on the same scheme as Fig. 3 and yielded similar results. Of most interest is the fact that *not even the mesio-distal and bucco-lingual dimensions of the same tooth in dentitions presenting the same form of arch, showed any correlation.*

On the examination of the possible correlation of the sizes of the teeth in the rest of the arch forms of the orang and in all the forms of the gorilla, the chimpanzee and gibbon, similar results were obtained. *It may, therefore, be*

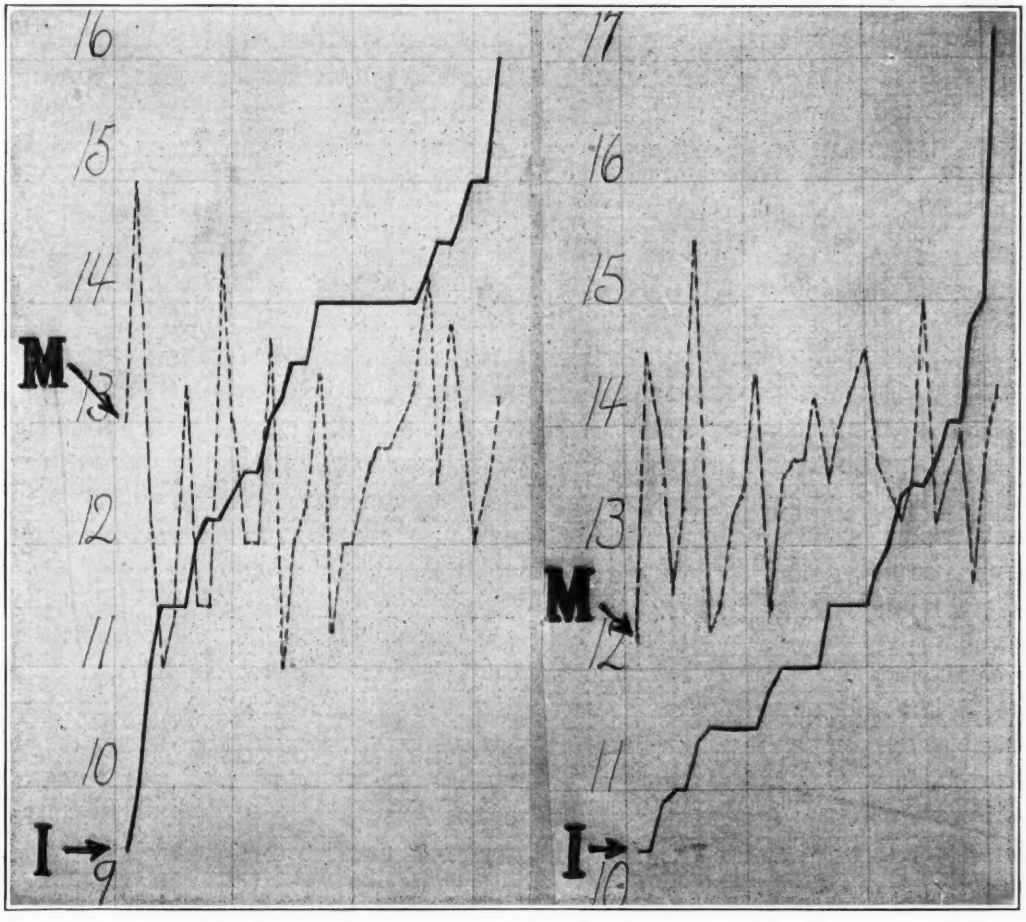


Fig. 3. Fig. 4.

Fig. 3.—Illustrating curves based on the mesio-distal diameter of incisor and molars of the dentitions conforming to one arch outline, showing no correlation in the sizes of these teeth. Heavy line marked I indicates incisor curve, broken line marked M, molar curve. Numbers indicate dimension in millimeters.

Fig. 4.—Illustrating labio-lingual dimension of the central incisor and bucco-lingual dimension of the first permanent molar as in Fig. 3 showing no correlation. (Markings as in Fig. 3.)

concluded that in the anthropoid apes the form of the dental arch has no relation to the size of the teeth.

Since professional engineers have become interested in orthodontia, a term has been coined for the purpose of expressing tooth dimensions quantitatively; that is, such words as "tooth-material" are employed; I presume to convey a similar idea of the structure of the dental arch as brick, steel or concrete is used in the construction of a building.

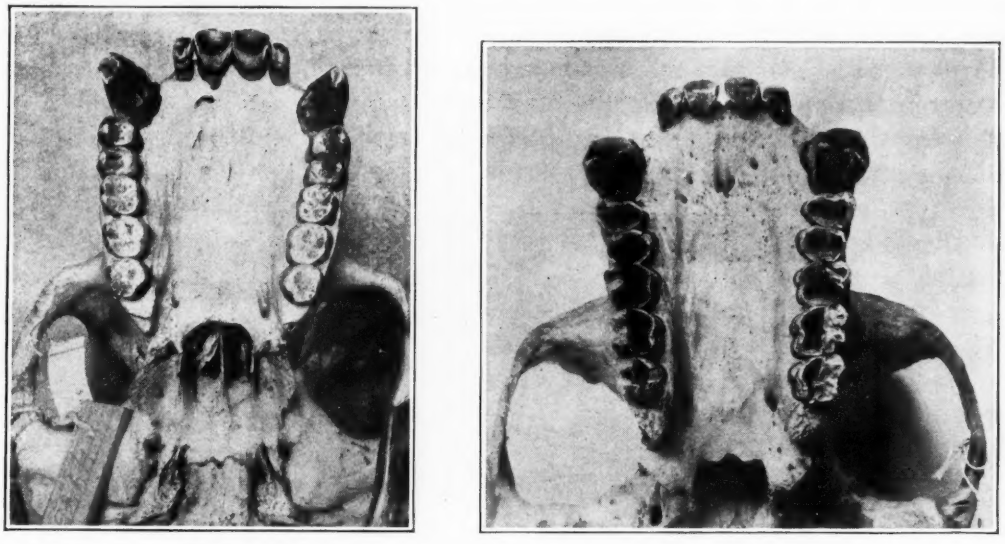
It must be stated at this point that the measurement of teeth is a very much

different, more difficult and less accurate process, for it involves a rather peculiar proposition. If the greatest mesio-distal dimension is obtained, it gives a diameter of the tooth at a level usually near the incisal edge or occlusal surface. If the labio-lingual diameter is given, the dimension is obtained at a different level usually near the gingival margin. We, therefore, possess dimensions of a rather peculiar character. They can neither convey an idea of the square as they are not obtained on the same plane nor of the cube as there are only two dimensions. Moreover, the levels of the teeth at which these dimensions are obtained represent such difference in form and contour that it is impossible to obtain a definite conception of the quantity of tooth structure involved. It is therefore erroneous and misleading to speak of tooth material when the quantity thereof can not be ascertained. A similar error was made by Dr. Bonville in the measurements of the "equilateral triangle" of the lower jaw. The points utilized were the centers of condyles and the interproximal space between the central incisors. The condyles as is well known are on a different horizontal plane than the occlusal surfaces of the teeth. The measurements were, therefore, obtained under similar complications. But this did not deter him or many others from formulating the pretentious methods so well known to the profession for ascertaining or "predetermining" the form of the dental arch.

Another pertinent question relative to tooth size and arch form may be asked of the dental mathematicians; namely, if the *form* of the dental arch is revealed by the *dimensions* of the teeth, why is it that despite the great difference in size between the upper and lower homologous teeth, all the calculations produce a like figure or outline for the form of the upper and lower dental arches? If a particular form of arch is obtainable only by one set of dimensions, and the same form is also obtainable by a different set of dimensions, as would necessarily be the case if the lower dental arch would be designed according to the same methods as employed for the upper, it may be inferred that the form of the dental arch is not so very much dependent upon the actual sizes of the teeth, but rather upon the methods of manipulating the figures involved. It has been stated, on the one hand, some time ago by Mr. Hanau, the originator of "orthodontic engineering," that one set of measurements may give rise to many different curves. But as it is demonstrated in practice different sets of measurements as obtained from the upper and lower teeth, respectively, may give rise to one curve for both upper and lower dental arches *it may be concluded that the mathematical method for disposing of this question is unsatisfactory.* Moreover, if there be any hope for a solution of the problem involved in the form of the dental arch, it must be sought for in other quarters.

Since form, according to the Standard Dictionary, is "the outward or visible shape of a body as distinguished from its substance or color; or the peculiar configuration by which an object is recognized by sight or touch," its explanation must proceed from the aspect of morphology. For, morphology, from the zoologic viewpoint, is the science of form and structure of animals, and being based on comparative anatomy and embryology lays the foundation of physiology. The form of the dental arch, to be thoroughly understood, must be interpreted from the morphologic aspect of its constituent parts before it is subjected to mathematical analysis for the purpose of "predetermining" it.

Thus, the teeth composing the dental arch of all placental mammals may easily be distinguished as belonging to either the upper or the lower dentition. For they differ generally in size, outline, contour and cuspidation. Owing to the difference in these general aspects, there is also a difference in their interrelation or occlusion. As will be shown later, the result of all these differences



A. *B.*

Fig. 5.—Illustrating pyriform dentition of orang and gorilla. *A.*—Occlusal view of orang dentition showing antero-internal position of canines in their mesio-distal axis and the generally rounded appearance of the curve of arch. *B.*—Occlusal view of dentition of gorilla showing a difference in the characters as outlined under *A*, i. e., antero-external position of the canines and the straight line assumed by the premolar-molar series.

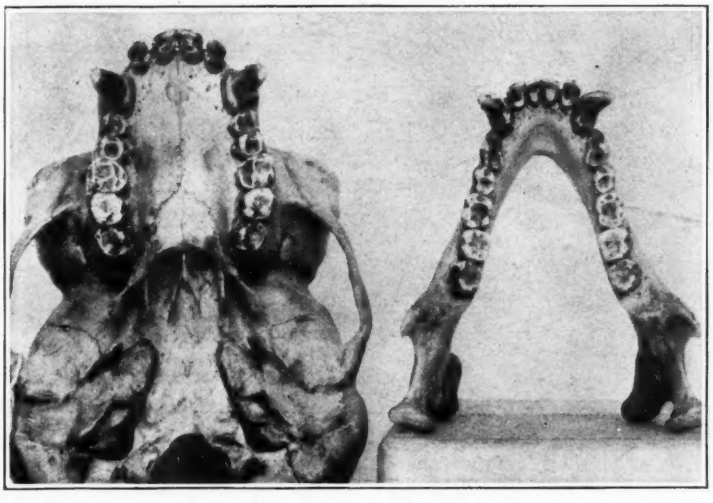


Fig. 6—Occlusal view of upper and lower dental arch of the gibbon showing position of canine and premolar in the conformation of the lyriform arch. It also shows a difference in arch outline of upper and lower jaws.

manifests itself in a concerted effect that brings about a difference also in the form of the dental arch. But, although it is of common knowledge that the form of the teeth of the upper jaw in all placental mammals differs from that of the teeth in the lower jaw, it is as yet not generally recognized that the form

of the dental arch in the two jaws does *not* usually correspond to the same outline. The extent of this occurrence will be evident by the following example: Among the gibbons examined 16.67% of the individuals exhibited a like form of dental arch in both jaws, while 83.33% differed; among the orangs 28.95% conformed to the same arch outline and 71.05% varied; the gorilla conformed in 43.48% of cases and varied in 56.52%; and the chimpanzee showed the same arch form in 41.67% of cases and varied in 58.33%. The interesting feature of it is that the larger the number of individuals examined, the higher the percentage of variation appeared. Thus, of 23 gorillas 56.52% differed in form; of 24 chimpanzees, 58.33% differed; of 76 orangs 71.05% differed and of 120 gibbons 83.33% differed.

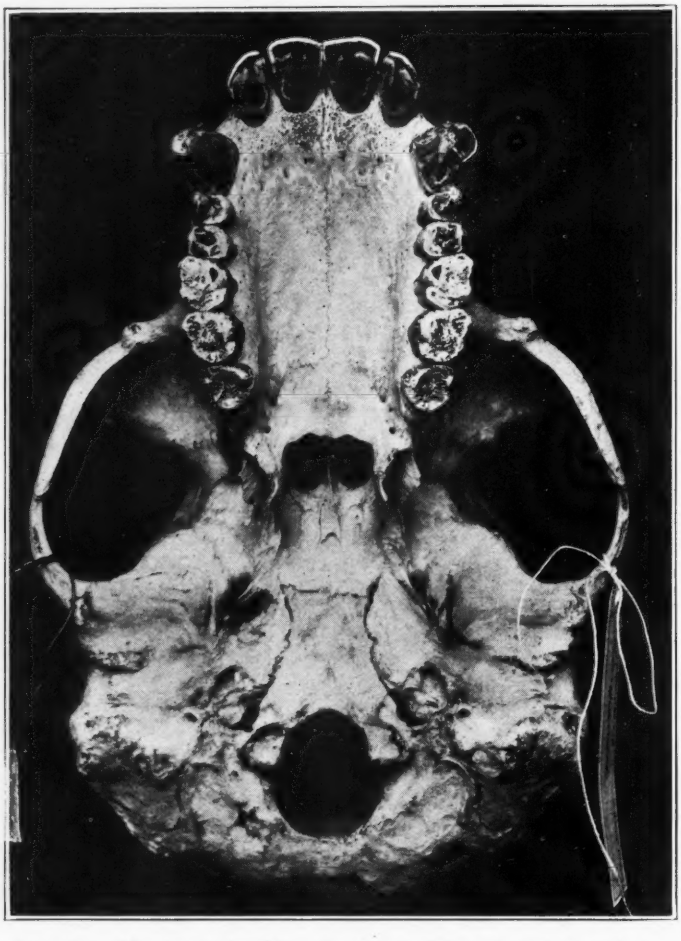


Fig. 7.—Occlusal view of a chimpanzee dentition showing position of canines and premolars in the conformation of the lyriform arch.

Upon further examination of the teeth of anthropoid apes, the fact was revealed that not only is there a difference in the form and contour of the teeth belonging to the upper and lower jaws, but there are also differences manifested in the homologous teeth of each jaw in the different genera. For instance, it is not difficult to demonstrate that the upper molars of the gorilla differ considerably in their proportions from those of the orang, chimpanzee, and gibbon. The gorilla's upper molars are more elongated mesio-distally, while

the diameter of those of the other apes is greater bucco-lingually. The molars of the gorilla are more angular, while those of the other apes are more rounded. The cusps of the gorilla molars are triangular while those of the others are rounder, nipple-shaped, flatter, etc. The effect of these differences upon the alignment of the buccal teeth in their respective arches is such as to produce differences that are peculiar to the gorilla arch form. Thus, while the buccal teeth of the gibbon, orang and chimpanzee tend more to an arrangement in curved lines, those of the gorilla assume their position in straight lines. Moreover, the arch forms of the upper jaw, of greatest frequency occurring in the gibbon, orang and chimpanzee, correspond to the pyriform, lyriform, U-shaped and O-shaped, while those assumed by the gorilla dentition are limited mainly to the U-shaped, pear-shaped and divergent, presenting none of the lyriform or O-shaped variety. (See Fig. 1.) But even in the pyriform arch, the gorilla variety has the buccal teeth in more straight lines than those assumed in the orang, as may be seen in Figs. 5, *A*, and *B*.

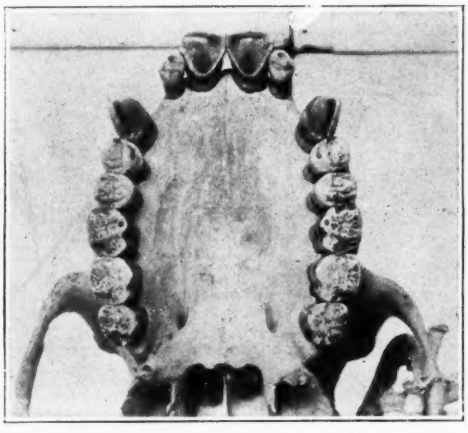


Fig. 8.—Occlusal view of orang dentition showing position of canines in the conformation of the O-shaped arch.

Also, the form and position of the canines seem to have an effect upon the conformation of the dental arch. Thus, in the gibbon, the upper canines are sabre-like in shape. And in position, their mesio-distal axis assumes such direction as to present the mesial end antero-externally. This peculiarity, combined with the tendency of the premolars to migrate lingually, gives the upper dental arch the lyriform appearance. In Fig. 6 the position of the canine in its relation to the lyriform arch may be clearly seen as well as the differently shaped lower arch of the same specimen.

In the chimpanzee, though the canine has more of a tusk-like appearance, it exhibits the same peculiarity in position as in the gibbon, and combined with a similar tendency of the premolars, the arch form assumes a similar outline (see Fig. 7). These characteristics in the gibbon and chimpanzee are so persistent as to produce at times exaggerations in the form of anomalous occlusal manifestations, where the upper second premolars drift into lingual occlusion to the lower.

In the orang, on the other hand, the upper canines present a tendency of rotating in a reverse direction, the mesial surface being antero-internally and as

a result, there is a more evenly rounded form of arch produced, as the pyriform and O-shaped arch, as may be seen in Fig. 5*A* and Fig. 8.

In the gorilla, on the other hand, the mesio-distal axis of the upper canine invariably assumes a direction parallel to the buccal cusp of the premolar-molar series. The result in the arch form is of a nature as may be seen in Fig. 5*B*.

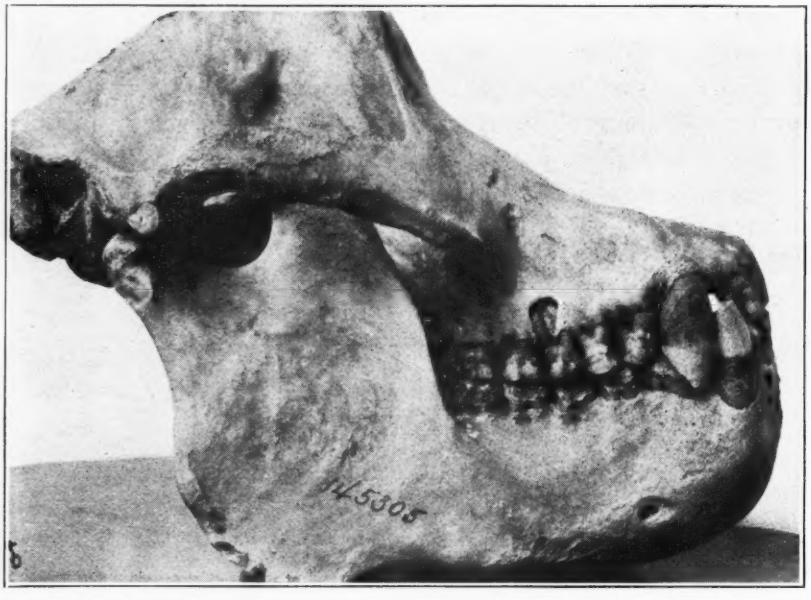


Fig. 9.—Side view of skulls of orang and gorilla. *A*.—Orang showing extreme curve of upper incisors in their long axis.

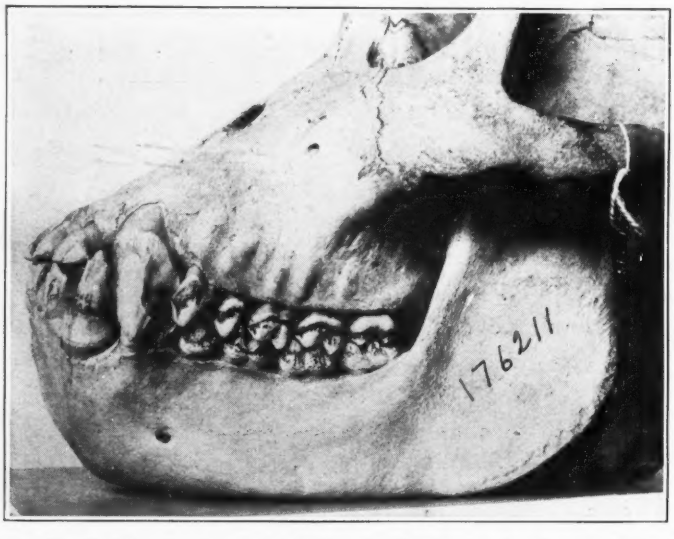


Fig. 9, *B*.—Gorilla showing straight line in the long axis of upper incisors.

The longitudinal axis of the teeth also shows a generic variability as may be seen in the incisor region of the gorilla as compared with the other genera. In the gorilla, the upper incisors are straight while those in the other genera are curved as is plainly visible in Figs 9, *A* and *B*.

As may be noticed in Fig. 6 (lower jaw) the position of the lower canine

is such as to present its labio-lingual axis anterior-posteriorly. The lower canine is therefore invariably included in the incisor curve in contradistinction to the upper which is more intimately associated with the premolar molar series. This difference in position of the canines in the upper and lower jaws, greatly influences the difference in form of the dental arches.

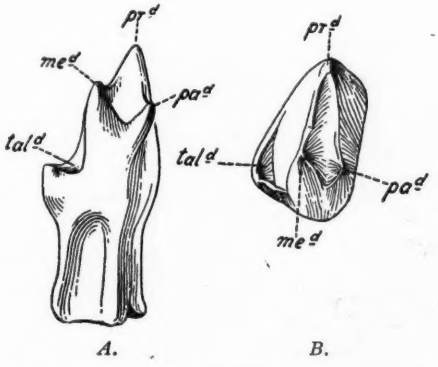


Fig. 10.—Showing lower left tritubercular molar of a primitive mammal (Phascolestes). *A.* Lingual view. *B.* Occlusal view (After Gregory).

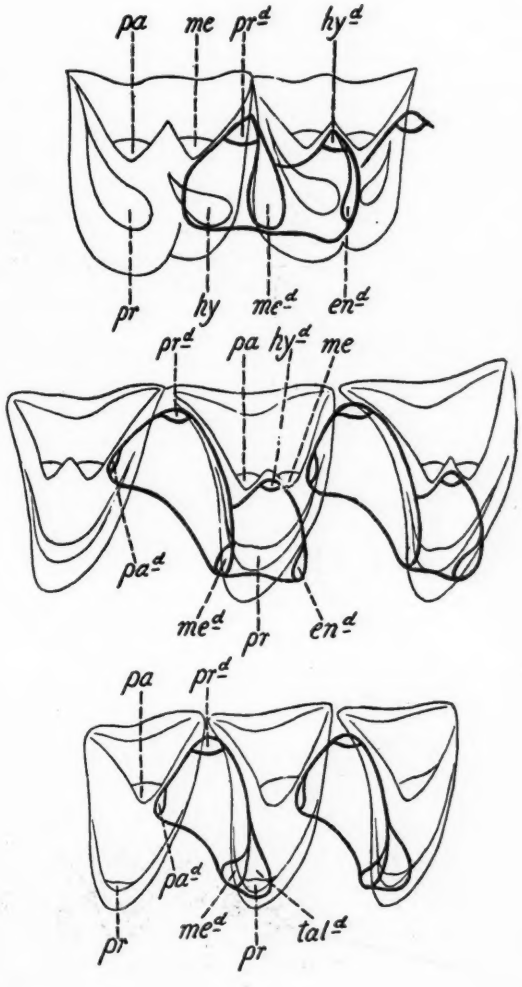


Fig. 11.—Illustrating occlusion of upper and lower molars in three stages of evolution. Lower teeth in heavy black lines. *A.*—Late Mesozoic stage, wedge-type occlusion. *B.*—Lower Eocene stage, based on many primitive mammals. Talonid of lower molars overlapping upper molars. *C.*—Upper Eocene and later stages antero-posterior diameter of molars increased talonid of lowers widened. (After Gregory.)

Fig. 11.

The difference in the form in the associated dental arches of one dentition, besides the causes already mentioned and those to be mentioned in subsequent contributions, may also be traced to certain positions of the molars and premolars and to their occlusion. It is a *primitive characteristic* of the upper molars to occupy such a position that the mesio-buccal angle is more prominent buccally than the disto-buccal angle. (See Figs. 5, 6, 7, 8, 16*D*). That is, if a line be drawn parallel to the buccal surface of the molars, its anterior end would point antero-externally. In occlusion, the mesio-lingual cusp of the upper molar, as is well known, is received in the central fossa of the lower corresponding molar. This is a primitive condition and is retained in the primates including man, although the

molar teeth have been modified during their evolution from a more ancestral type. The disto-lingual cusp of the upper molar, on the other hand, is received in the anterior or mesial fossa—the fossa situated between the mesial marginal ridge and the mesial inclines of the mesial cusps—of the lower molar behind. It de-

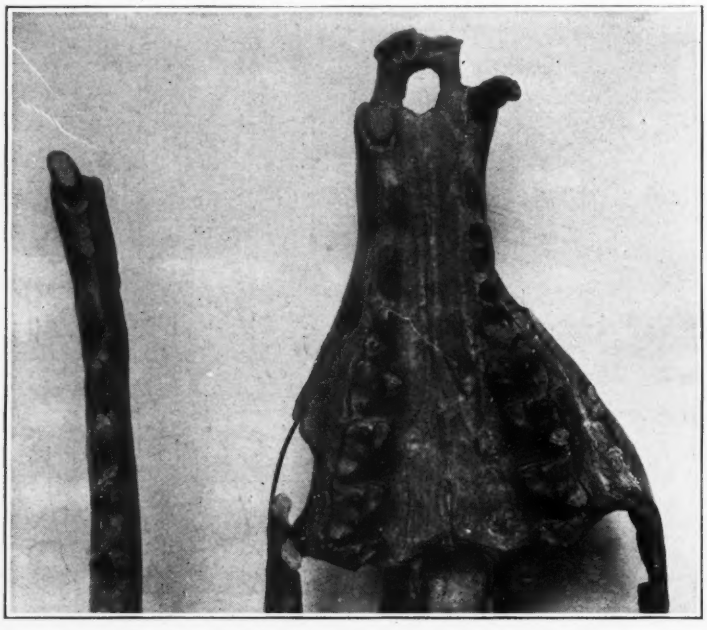


Fig. 12.—Occlusal surface of upper and half of the lower dentition of an Eocene carnivore (Sinopa) showing upper tritubercular molars and lower molars with fully developed heel.

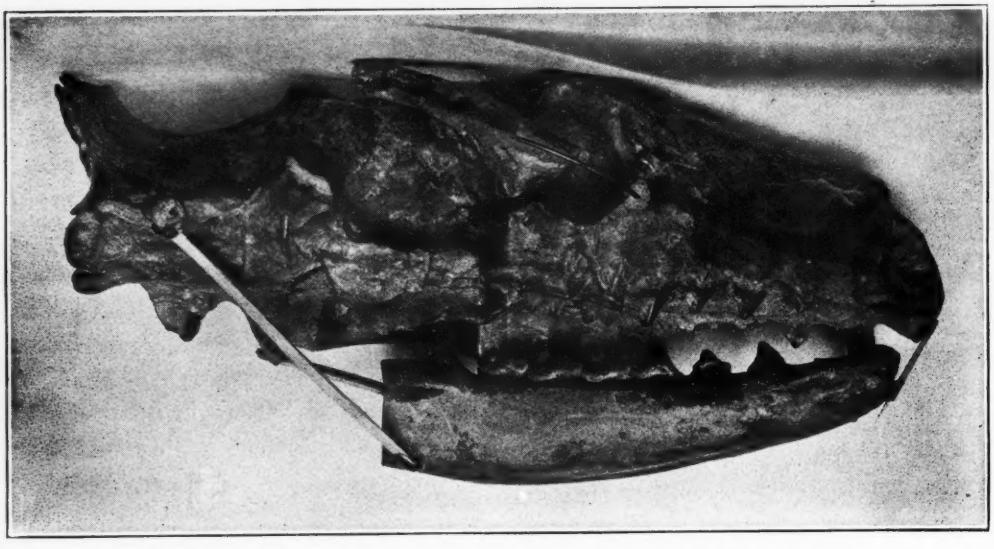


Fig. 13.—Lingual view of dentition in occlusion of Eocene carnivore showing the lingual cusp of the upper molar fitting into the central fossa (talonid basin) of the lower molar.

pends, therefore, upon the position and form of the disto-lingual cusp of the upper molar as to the direction that the mesio-distal axis of the lower molar behind will take. And in proportion as there is the slightest variation in the primitive position of the upper molar in a rotary direction there will be an in-

verse modification of the alignment of the lower molars. As the mesial side of the upper molar will turn lingually the mesial side of the lower molar behind will turn buccally.

Another probable factor showing some influence upon the form of the dental arch is closely associated with the evolutional process affecting the modification of the original tooth pattern and the occlusion of the dentitions of various placental mammals. Time and space will not permit to go into any detail at present, its elaboration being made in a subsequent contribution. Suffice it now to refer to this topic in a casual and general manner. Thus, it is a well-established fact, borne out by adequate and authentic paleontologic evidence that all placental mammals, according to Cope,[2] have at some period in the course of evolution passed through the tritubercular type of molar pattern. The tri-

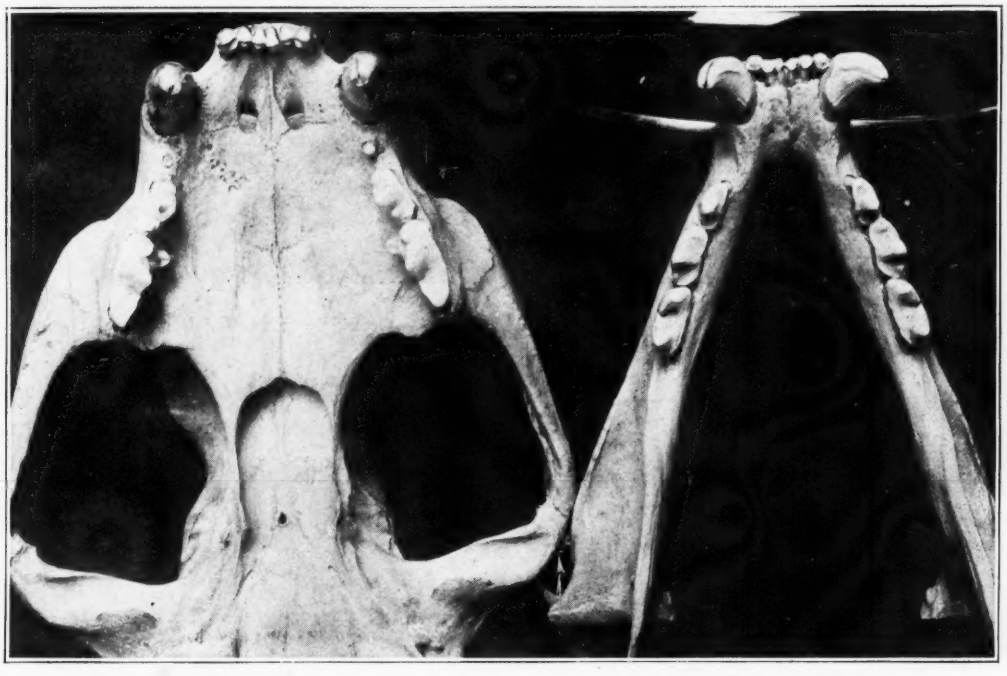


Fig. 14.—Occlusal view of modern carnivore (Puma) showing the extreme modifications in the dentition and the form of arch.

tubercular tooth, as may be seen in Fig. 10, *A* and *B*, presenting the lingual and occlusal views, respectively, of a lower left molar of a primitive mammal (Phascolestes), of the upper Jurassic age, consists of three principal cusps and a rudimentary heel or talonid. The cusps are connected by marginal ridges. The occlusion according to Wm. K. Gregory[3] is of the interlocking or Wedge type as may be seen in Fig. 11, *A*. The lower molar fits into the interdental spaces of the upper.

During the further evolution, the subsequent stages of development are reached both in the modification of the tooth pattern and manner of occlusion as may be seen in Fig. 11, *B* and *C*. There is accordingly a continuous increase in the heel of the lower molars, and the occlusion is thereby changed from the interlock or Wedge-type to the interlocking and lapping type which persist

through the various orders of placental mammals and in a modified form even in man. This modification in the teeth and occlusion of the early predecessors may have had a strong influence, affecting the form of the dental arches in subsequent time.

Thus, we see in Fig. 12 (Sinopa) representing the casts of a fossil of an Eocene carnivore, the upper molars are still of the tritubercular type while the heel is fully developed in the lower. The lingual occlusion as may be seen in Fig. 13, shows the protocone or lingual cusp of the molar fitting into the heel

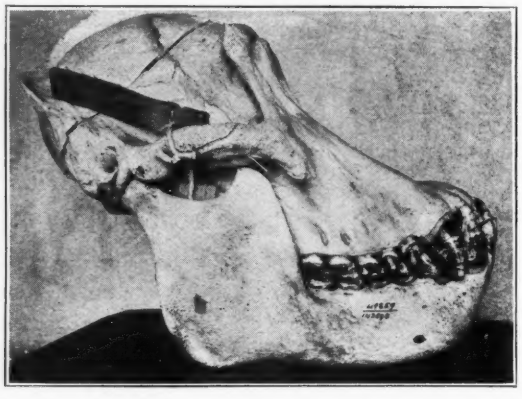


Fig. 15.—Side view showing incisor occlusion in the orang. *A*.—Orang dentition showing edge-to-edge bite.

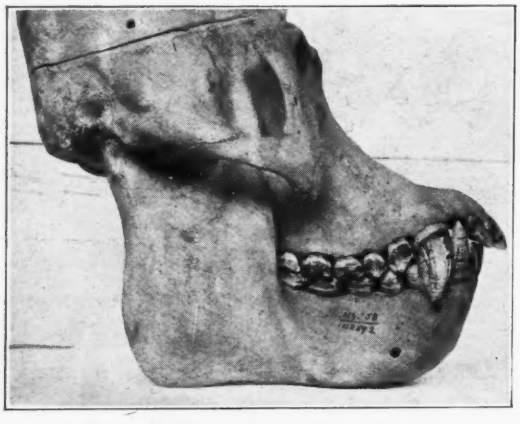


Fig. 15, *B*.—Orange dentition showing overbite.

basin of the lower molar. This characteristic must be kept in mind for it is one of the most primitive features retained in modern forms.

The type of dental arch forms as seen in the Eocene carnivore (Sinopa), is considerably changed in the modern carnivora, as may be seen in Fig. 14 (Puma). Though still bearing a very *slight* resemblance in outline, the arches are considerably shorter and wider. The teeth, as may be observed, have undergone a considerable modification not only in form but also in number. The dental formula of the Eocene predecessor being I3, C1, P4, M3 in both upper and lower

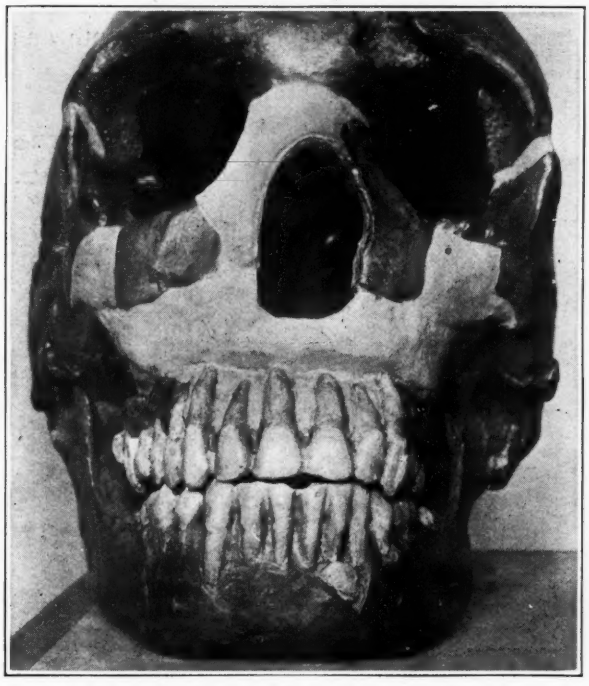


Fig. 16.—Illustrations of casts of the Mousterian skull. *A*.—Showing anterior view and incisor edge-to-edge occlusion.

Fig. 16*B*.—Side view probably normal occlusion.

jaws while in the present carnivore it varies from $\frac{3,1,4,2}{3,1,4,3,}$ in dogs (bears, etc., to $\frac{3,1,3.1}{3,1,2,1}$ or 0 in felines (Fig. 14). Similar changes in tooth and arch form have been traced in the various orders of placental mammals.

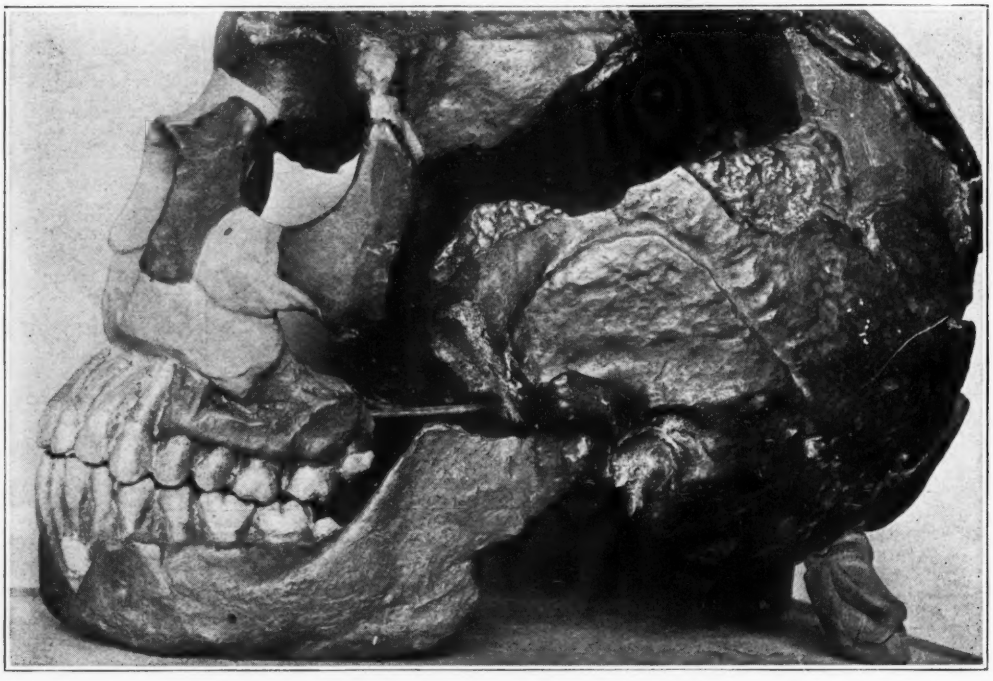


Fig. 16*C*.—Side view probably normal occlusion.

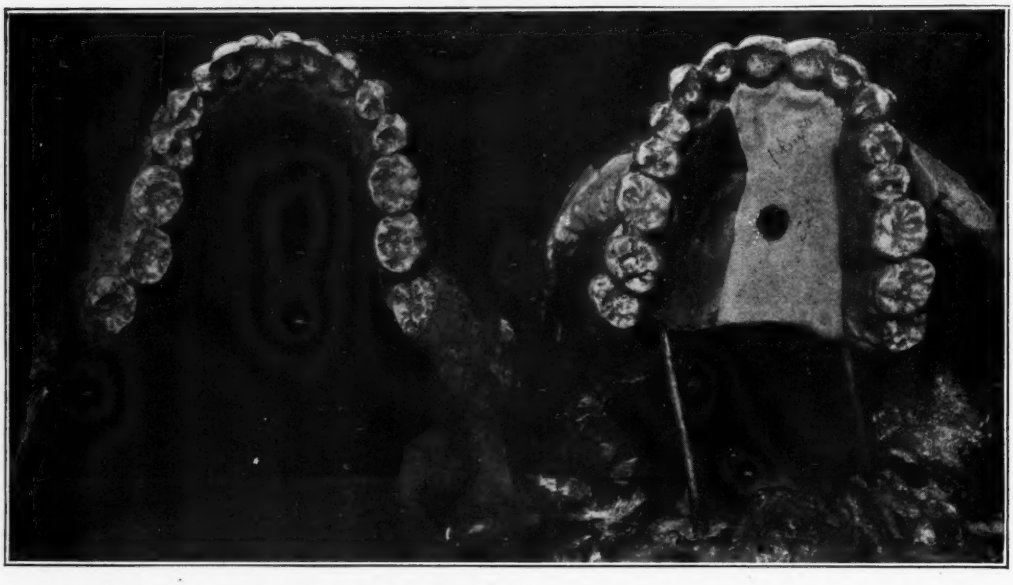


Fig. 16*D*.—Occlusal views, showing difference in the form of the upper and lower arches. In *A* and *C* the lower left permanent canine may be noticed as it is impacted below the alveolar process.

The shortening of the muzzle in the course of evolution brought about a twofold effect upon the dentition in different orders of placental mammals. Thus, as is seen in the carnivora, the shortening occurred posteriorly resulting in the reduction of the number of molars and premolars, while in the apes and man the reduction took place anteriorly in the premolar and incisor region. The anthropoids and man therefore have lost one incisor, probably the third, and the first two premolars of the original placental mammalian formula.

The consequent effect upon the original form of the primate dental arch is therefore closely associated with the modification in form and number of the teeth.

Another point of noteworthy significance is that the incisor occlusion in the various arch forms is never alike. It may be either in an edge-to-edge or in an overbite relation, as may be observed in different orders of mammals. For in-

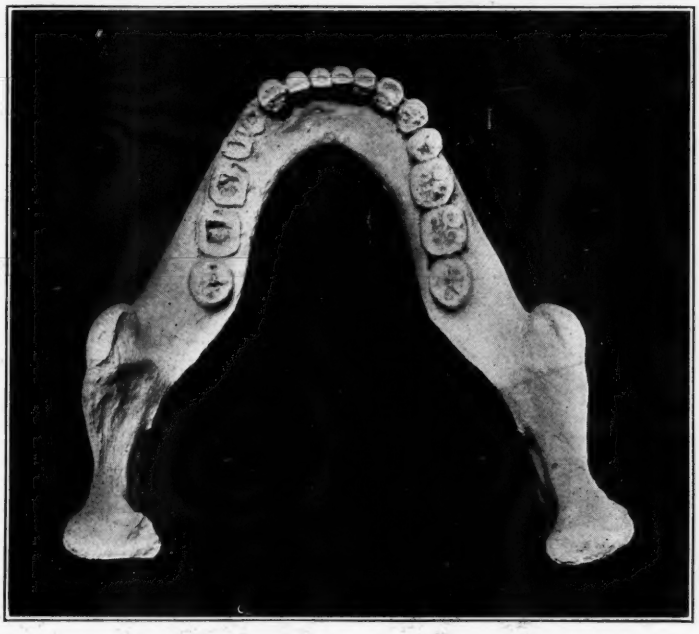


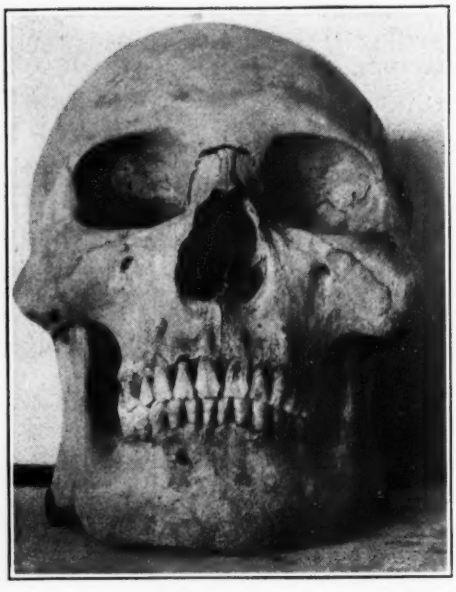
Fig. 17.—Occlusal view of jaw of the Heidelberg jaw, showing canines included in incisor curve, and the premolars as the prominent points in the arch.

stance, in carnivora or perisodactyls it is an edge-to-edge, and in rodents it is an overbite relation. But this may also be observed in the apes and man. Fig. 15, A and B illustrates the incisor occlusion as found in the orang.

In the study of the dentition of man, these features must be kept firmly in mind. For, although they apparently are irrelevant in the relation to the human teeth, they will become important factors as their significance is appreciated.

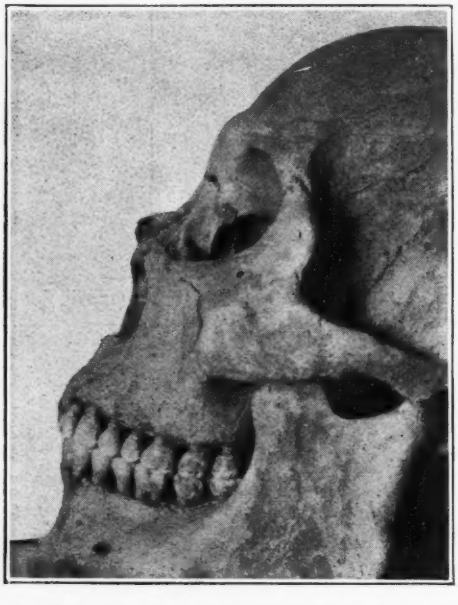
Thus, early complete human dentitions manifest characteristics closely allied with those observed in the anthropoid family.

Fig. 16, *A, B, C,* and *D* presents the restored casts of a skull of one of the early forerunners of modern man, *Homo Mousteriensis.* (The skull belongs to the J. Leon Williams collection on exhibition at the American Museum of Natural History, New York.) The individual belonged to a Neanderthaloid Race and is estimated to have existed about 40,000 years ago. As will be ob-

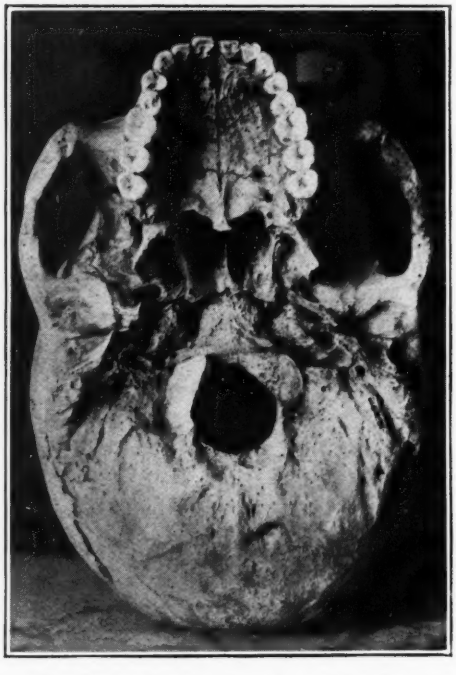


A.—Front view showing considerable overbite in incisor region.

B.—Right side showing buccal teeth in "normal occlusion."



C.—Left side showing buccal teeth in "normal occlusion."



D.—Occlusal view, showing difference in conformation of the upper and lower dental arches.

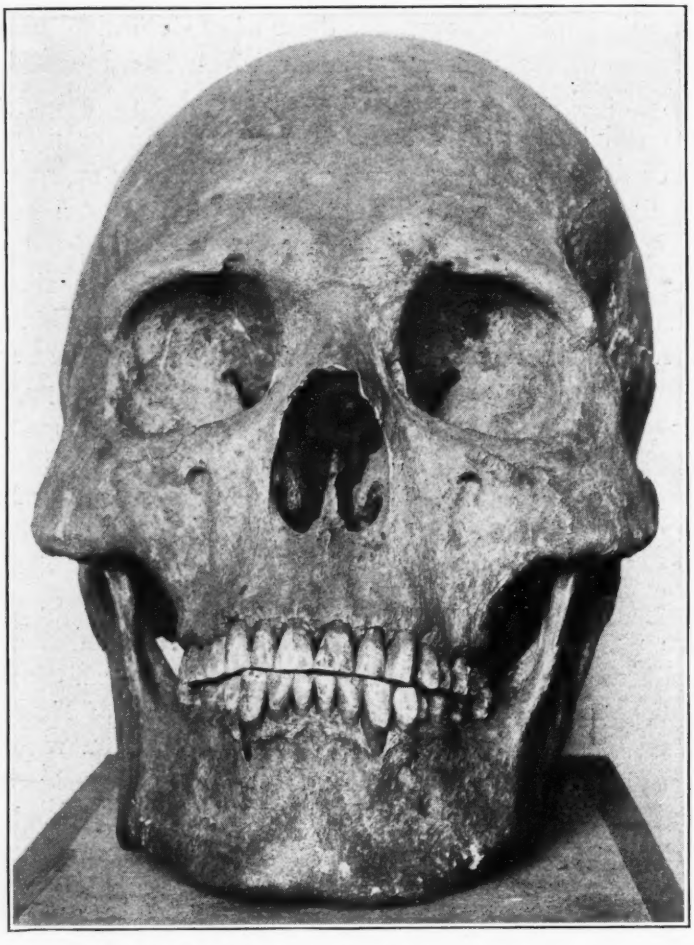
Fig. 18.—Mongolian skull showing dentition in "normal occlusion."

served in Fig. 16, *D*, the teeth resemble those of modern man in form with the probable exception of the upper first molar which has a considerably larger disto-lingual cusp and the lower second premolar also exhibiting a similar increase in the distal half of its crown. The upper arch, as may be seen, resembles that of modern man quite closely, while the lower approaches more the form of more primitive races, as will be seen at once. Fig. 17 shows the occlusal surface of a cast by Professor McGregor, representing the lower jaw of the oldest human relic, the *Heidelberg Man.* Note the form of the dental arch as well as its close relationship to that of the Mousterian lower dental arch. In these, as well as in other primitive specimens of man and anthropoid lower dental arch forms, it is noticed that the canines do not form the prominent points as they do in the upper arch of the Mousterian and of some modern human forms, but rather are included in the incisor curve, so to speak, allowing the first or the second premolar to indicate the turning points of the curve of the arch. The statement must not be omitted that the occlusion of he Mousterian dentition was in all probability normal, but owing to a certain degree of warping in the right condyle region, the teeth are prevented from coming into close apposition.

In modern man, it is generally understood that the dental arches assume a like form in both the upper and the lower jaw. The examination of 3776 skulls both at the American Museum of Natural History of New York and at the United States National Museum at Washington, D. C., revealed the fact that also among the modern races of man, there is found considerable variation in this relationship. The illustrations in Figs. 18, 19, 20, 21, and 22 represent some of the best dentitions in normal occlusion selected from among the skulls examined. Thus, Fig. 18 represents a Mongolian skull, and its dentition as may be seen in *A, B, C,* is in normal occlusion. The premolar-molar series as seen in *D* and *E,* are similarly aligned in both jaws, but there is a difference in the curve of the anterior region; the upper arch presenting a different curve in the incisor-canine region than the lower. It must also be noticed that in the lower arch of these skulls, there is a considerable similarity in the anterior curve to the primitive form, the premolars forming the most prominent points. This peculiarity may be noticed in all the skulls illustrated. It is also of noteworthy significance to observe the considerable overbite in the incisor occlusion despite the fact that the teeth are considerably worn from use.

An extreme difference may be noticed in Fig. 19, *A, B, C,* and *D,* (Illinois Indian) the upper arch (*D*) being round in contour, while the lower approaches the saddle-shaped form of the anthropoids. Notice the edge-to-edge occlusion of the incisors, an Indian peculiarity. In the Eskimo, Fig. 20, *A, B, C, D,* and *E,* as will be seen, the upper arch forms are extremely broad and rounded in contour, converging slightly posteriorly, while in the lower the premolar-molar series are arranged in straight lines diverging posteriorly.

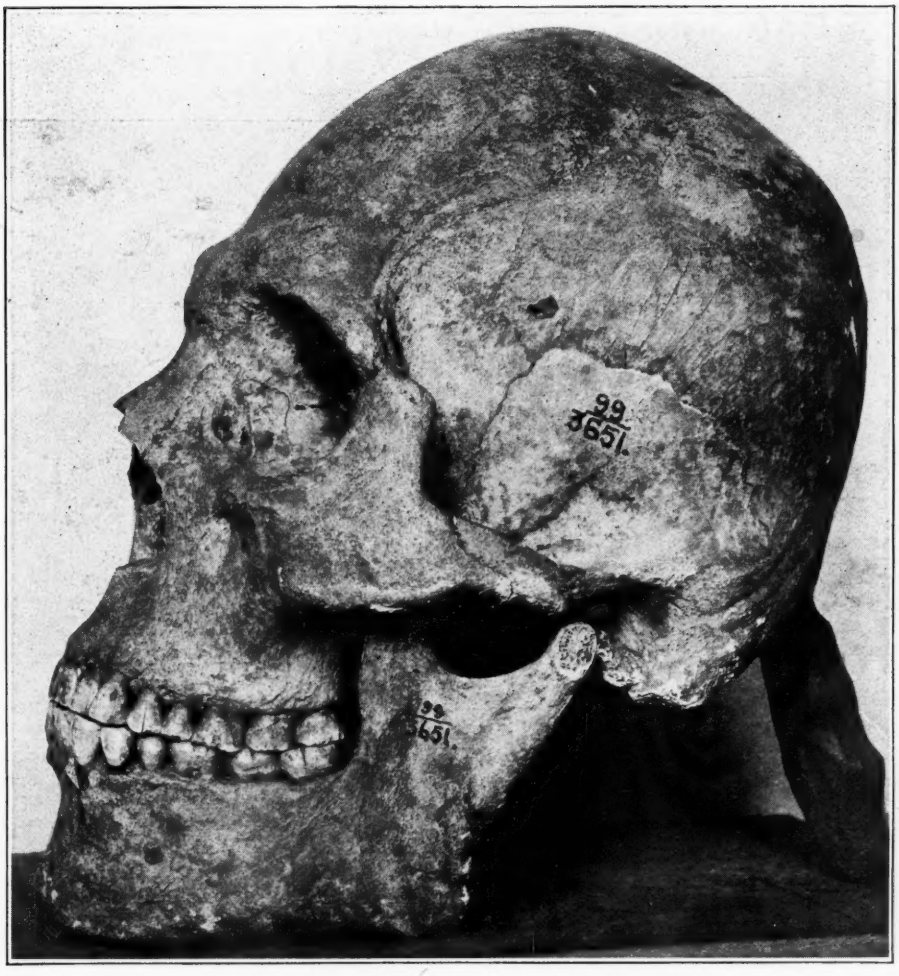
The Hindoo, Fig. 21, *A, B, C, D,* and *E* though exhibiting a contrasting upper arch form from that of the Eskimo, shows again a marked difference between the form of the upper and the lower jaws (See Fig. 21, *D* and *E*). Even the European White, Fig. 22, *A, B, C,* and *D,* shows that differences exist, as may be noticed in the evenly rounded alignment of the upper premolar-molar series



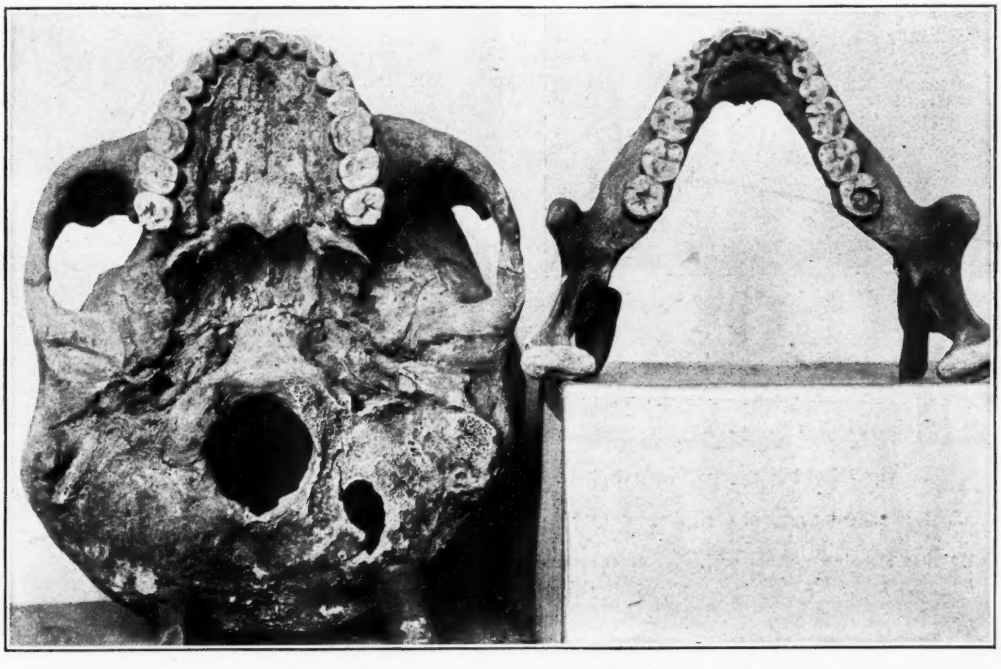
A.—Showing edge-to-edge relation of incisors.

B.—Right side showing normal relation of the buccal teeth.

Fig. 19.—Skull of Illinois Indian with teeth in "normal occlusion."

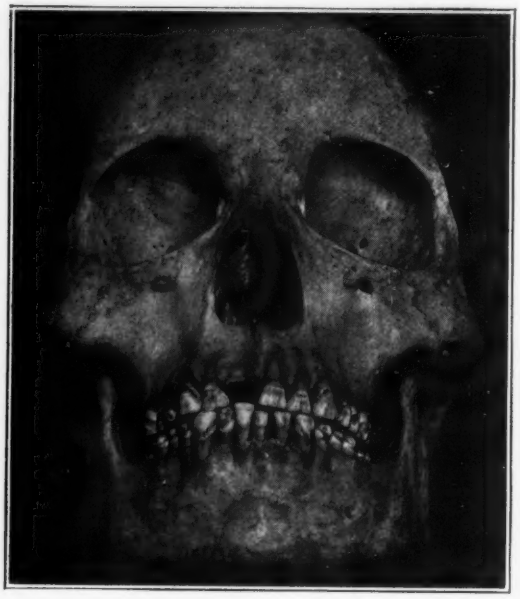


C.—Left side showing normal relation of the buccal teeth.

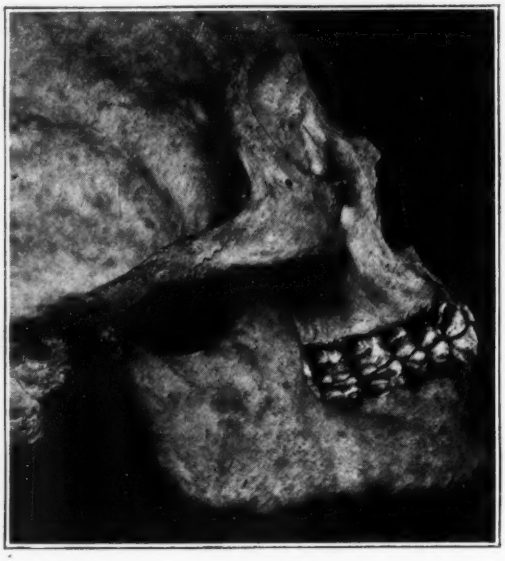


D.—Occlusal view, showing considerable difference in conformation of the two dental arches.

Fig. 19.—Skull of Illinois Indian with teeth in "normal occlusion."

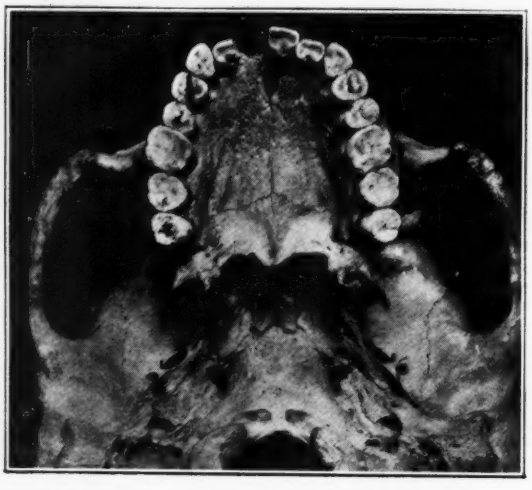


A.

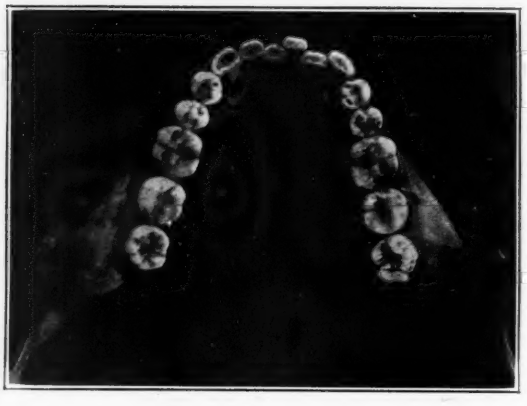


B.

C.



D.



E.

Fig. 20.—Eskimo skull with dentition in normal occlusion.

A.—Anterior view showing edge-to-edge relation of the incisors.

B.—Right side showing normal occlusion of the buccal teeth.

C.—Left side showing normal occlusion of the buccal teeth.

D.—Occlusal view of upper arch, showing difference in form from that of the lower.

E.—Occlusal view of the lower arch illustrating its variability in form from that of the upper.

as compared with the straight alignment of the lower homologous teeth. Also the primitive curve in the lower inciso-canine region may be observed.

The point, however, in which all these dentitions coincide is the primitive position of the molar teeth, the difference in the prominent points in the curve of the upper and lower arch, and the primitive cusp occlusion of the molars. The incisor occlusion, again as in the apes, is either in an overbite or in an edge-to-edge relation.

In summing up what has been stated, the following points may be emphasized:

1. That the tests made to ascertain whether there is any correlation between the size of the central incisors, based on individual and average dimension, and any particular form of dental arch in the anthropoid apes failed to prove the affirmative.

2. That the tests made to ascertain whether any correlation may be found in the dimensions of the central incisors and those of the first molars in the dentition of anthropoid apes having a like form of dental arch also failed to prove the affirmative.

3. That the difference in contour of the molar teeth of the gorilla, as compared to the other anthropoids, was found to have some bearing on the forms of dental arch in that genus; showing a probable generic difference in the anthropoid apes.

4. That the form and position of the canines and premolars in all anthropoids have a morphologic influence upon the outlines assumed by the various dental arches.

5. That evolutional processes influencing such modifications as number, form, position and occlusion of the teeth, constitute a noteworthy factor in the establishment of form in the dental arches not only of the various placental mammals in general, but also of the apes and man.

6. That the forms of both the upper and lower dental arches in the anthropoids in the same individual *may conform* to the one outline but in the *greater percentage of cases they differ.*

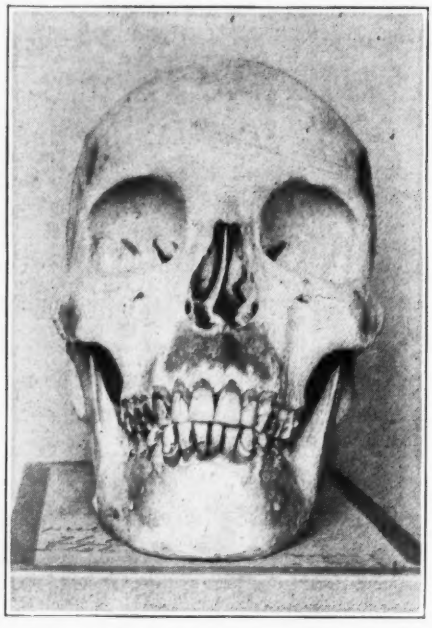
7. That this difference may be due to a fundamental difference in the pattern of the teeth in the two jaws, as well as to the adherence to the primitive position of the molar teeth in the upper jaw.

8. That the extreme diversity in form of the human dental arch fails to obscure similar conditions as in the anthropoids. Thus, the difference in tooth pattern in the two jaws, primitive position and occlusion, also produces in man a difference in the form of the two dental arches constituting one denture.

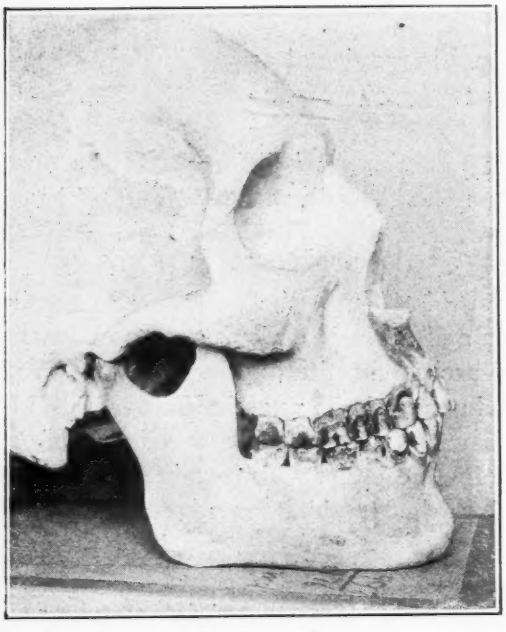
9. That the incisor occlusion in the human skulls examined, like that in the ape, is of a two-fold character. It may be in an overbite or edge-to-edge relation. And also that this is found to be in association with certain races more than with others. Thus, the Indians and Eskimos exhibit an edge-to-edge occlusion, while the whites and Hindoos a moderate overbite, reaching an extreme condition in the Mongolians.

10. And last, owing to the tendency of some races to exhibit certain associations with particular form of other features, as of head, nose, eyes, etc., it may eventually be proved that besides other factors, racial characters may

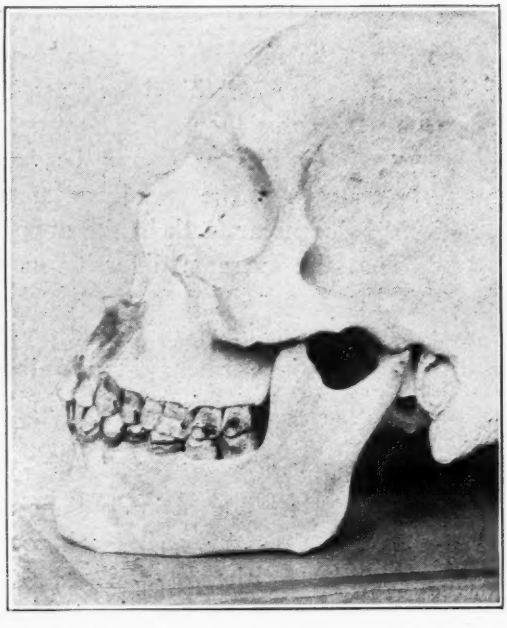
also stand in close relationship to the morphology of the dental arch. This, however, requires considerably more study, and will depend upon further investigation of this problem to reach a stage in which such conclusions may be arrived at with more certainty. With this end in view, too much credit can not be given to the American Museum of Natural History of New York and the U. S. National Museum of Washington for the remarkable work that is being done



A.—Anterior view showing moderate overbite of incisors.



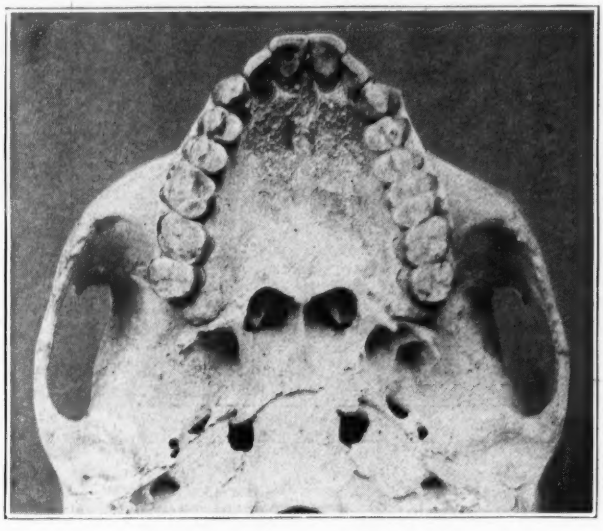
B.—Right side showing normal relation of buccal teeth.



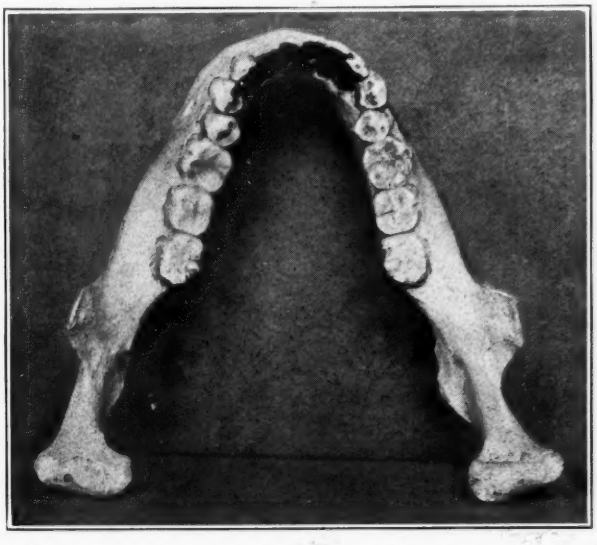
C.—Left side showing normal relation of buccal teeth.

Fig. 21.—Hindoo skull showing dentition in normal occlusion.

in gathering and harboring the wonderful collections. I must also express considerable gratitude to the men connected with those institutions for the readiness and willingness with which they assisted me in the investigation conducted there. Special mention must be made of the kindness shown me by Dr. Hrdlicka, Dr. Miller of the U. S. National Museum; and to Dr. Wm. K. Gregory of the American Museum of Natural History for the keen interest he is taking in all matters pertaining to teeth.



D.—Occlusal view of upper arch showing considerable difference in form from that of the lower arch.



E.—Occlusal view of lower dental arch, showing its variability in form from that of the upper.

Fig. 21.—Hindoo skull showing dentition in normal occlusion.

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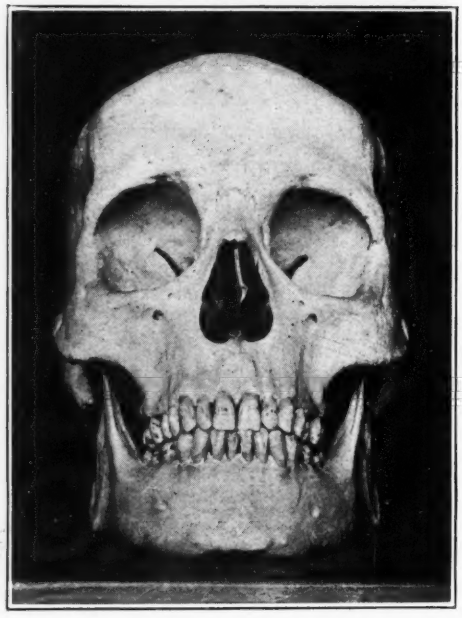
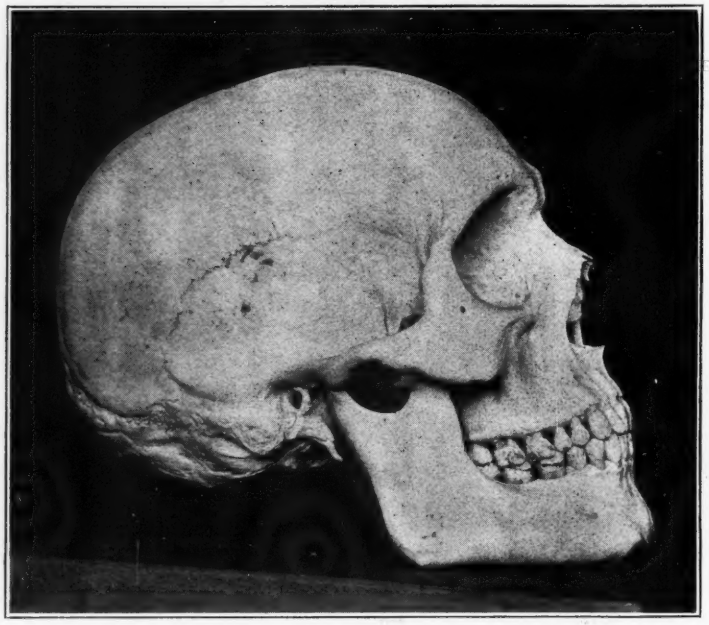
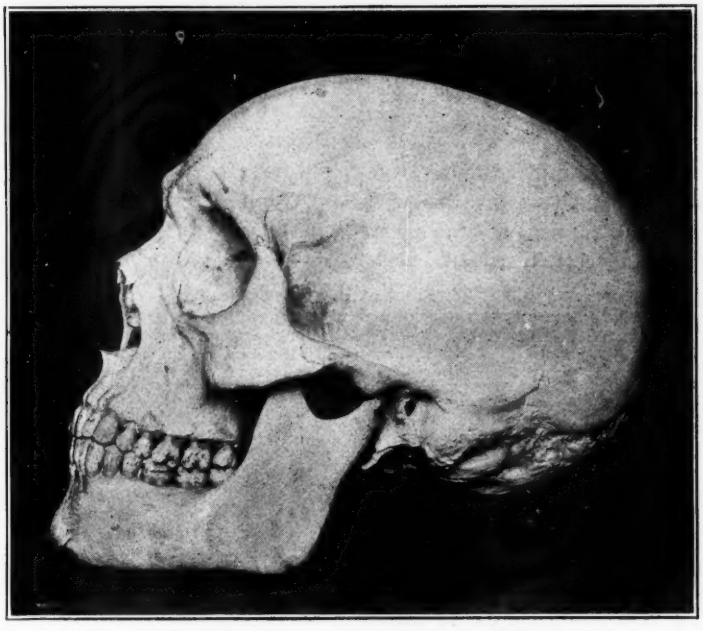


A.—Anterior view showing moderate overbite of incisors.

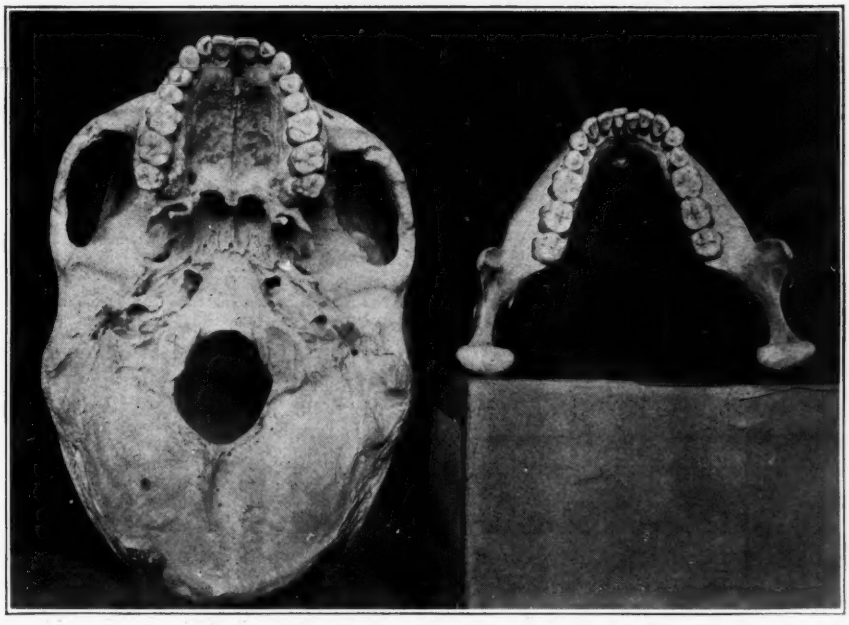


B.—Right side showing normal relation of buccal teeth.

Fig. 22.—European White Skull showing normal occlusion.



C.—Left side showing normal relation of buccal teeth.



D.—Occlusal view showing difference in curve of the two dental arches.

Fig. 22.—European White Skull showing normal occlusion.

DISCUSSION

Dr. Martin Dewey, Chicago.—Mr. President and Members: I am very glad to discuss this paper for several reasons. First, because I am not going to apologize to you for not having seen the paper in order to discuss it. Second, because the title of this paper, "Dimensions Versus Form in Teeth and Their Bearing on the Morphology of the Dental Arch" is a subject which has been written about considerably in the last few years.

As Dr. Hellman mentioned, several attempts have been made by measuring the teeth to predetermine the shape of the dental arch. All of these various plans have a good many points that are similar, and about all one can say for these attempts is this: that they are simply taking certain types or certain skulls and following out an average. There

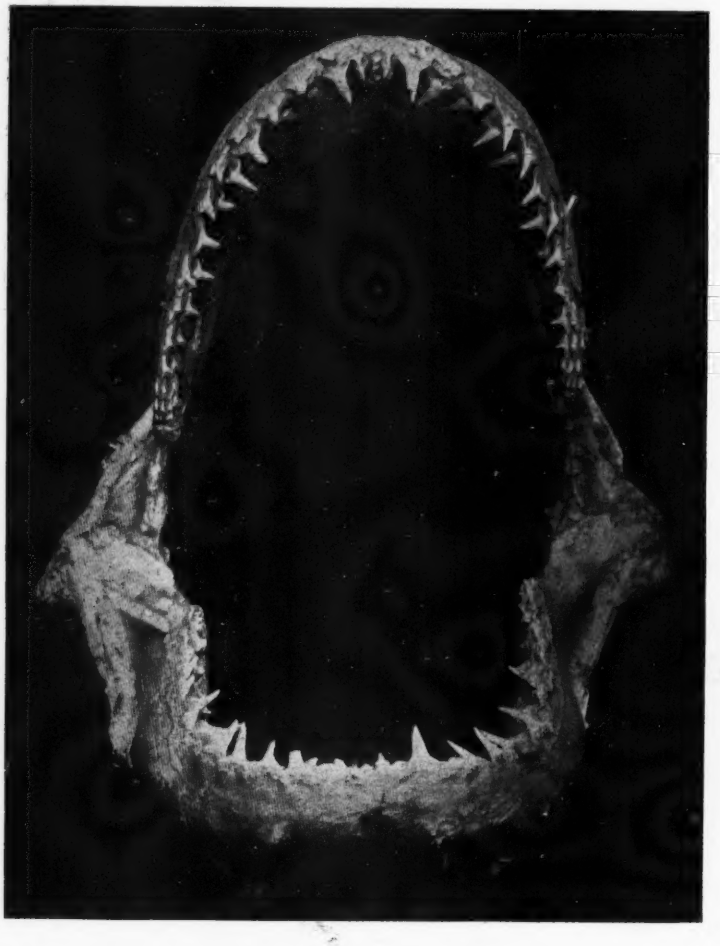


Fig. 1.

is nothing, as the doctor has shown you, scientific about it, and about two years ago in a discussion with one of the foremost men in dental engineering, I asked him the question, can you do this with any skull or animal? If you can scientifically predetermine the dental occlusion in man, you can do it in animals. He contended that he could do it, but I believe it can not be done because the teeth vary so much as regards arch form.

Dr. Hellman has shown a series of forms of arches in anthropoids, and in order to more fully substantiate or prove the fact that the shape or dimensions of the teeth have very little or nothing to do with the form of the arches, I will go back several million years still further in evolution and show you some of the things nature attempted when she first started.

To again call your attention to some of the things I mentioned this morning, you must keep in mind constantly the fact that function was used to play a great part in determining the shape of the dental arch as well as the supporting structures.

In this shark (Fig. 1), much like the opossum, we find another living fossil. You have one of the first attempts made towards the formation of a dental apparatus. There is absolutely no connection whatsoever, as you can see, between the tooth form, the diameter of the tooth, and the dimensions of the teeth and shape of the arch, because he has teeth with approximating surfaces which are conical and have existed there as a result of function and use on the part of nature. There is simply a bunch of placoid scales grown back from the oral cavity that are beginning to perform the primary function of prehension.

Passing on to another group, we find the result of function and use has changed the shapes of the teeth, until we find sharp cutting teeth in the upper arch and spear-shaped teeth in the lower arch for performing the functions of incision and prehension. The

Fig. 2.

lower teeth, which perform the function of prehension, are different in shape, and the whole thing is not a question of dimensions of teeth, but a question of the influence of function upon the parts.

Passing on to the prehensile and carnivorous type of teeth we find the premaxillary bone and maxilla has been elongated. We have a series of conical teeth (Fig. 2). You could not measure these cones and arrive at an idea of how the arch is shaped. If there is any scientific rule in measuring the arch it will work in one case as well as the other. Biology can not be worked out by mathematical formulæ as the doctor shows. You can not regulate teeth by mathematical rules or calculations. Unfortunately in man the dental arch has passed through the process of evolution until we have a certain shaped form approaching a circle or curve which you can seemingly measure, for anything that approaches a curve can be measured to a certain extent by rule. Anything that follows a

sphere can be studied in accordance with the law of average, but it may not have any bearing whatsoever. These measurements follow a certain variation, and this variation has some bearing on the question we are discussing.

Take this one case (Fig. 3) in the series where evolution has proceeded. This is one of the inferior reptiles. Here we have a series of conical teeth. If you measure one of these teeth you could not say how long or wide the arch would be (Fig. 3). The width of that was determined by function along with the evolutionary changes, and many factors were brought to bear on it at that time. I am showing these extremes to point out the fact that there is no law or rule whereby the dimensions of the teeth have anything to do with the shape of the arch. If it were a fact and had any biologic importance, it would work

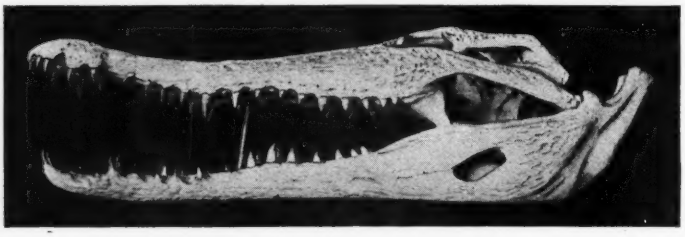


Fig. 3.

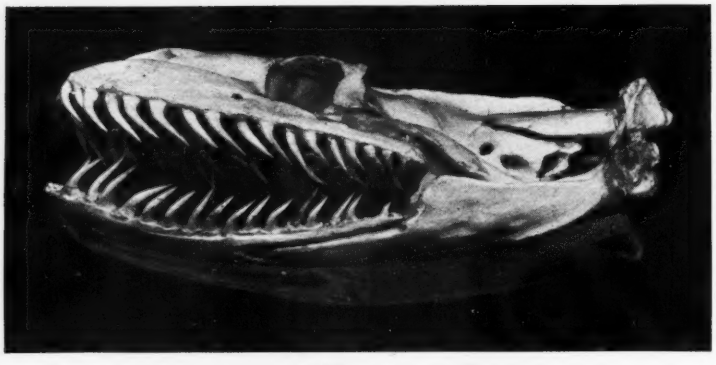


Fig. 4.

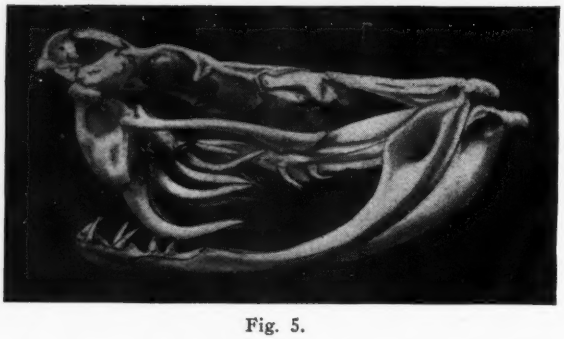


Fig. 5.

in one animal as well as in another. You can not pick out man and make a biologic law for him that will not hold in the rest. If you have a biologic law that will apply to man, its application should be similar in animals.

The crocodiles and alligators have conical-shaped teeth, but nothing whatsoever will determine the shape of the arch. The teeth being conical makes necessary the function of prehension, and the muscles of mastication and the temporo-mandibular articulation are arranged in accordance with the function.

If we take the species of nonpoisonous and poisonous snakes which are closely re-

lated, we find a vast difference between the poisonous and nonpoisonous snakes occurs in the shape of the arch, in the anatomic structure of the arch because of the different functions of the teeth. In the nonpoisonous snakes (Fig. 4) the whole function is that of prehension and deglutition, and the maxillary and premaxillary bones are shaped accordingly. In the poisonous snakes we find the whole thing modified because the function of the poisonous fangs makes necessary modification of the premaxillary bones and modification of the temporo-mandibular articulation as well as a hinge-joint between the premaxilla and maxilla (Fig. 5). The shape of the fang has nothing to do with the arch form in the different species, but the function of each tooth has played a part as observed in animals. The reason some animals have existed and others have perished is that in the race of life the teeth have not evolved, or some part of the animal has evolved which has enabled him to live in the environment he was subjected to at that time.

Here is an illustration (Fig. 6) showing the typical conical teeth of the armadilla in which each cone has no relation to arch forms or dimensions of the teeth, and in fact, these teeth have got to the point where they are more or less rudimentary. The animal

Fig. 6.

Fig. 7.

can live without these teeth because the tongue and the roof of the mouth have usurped the function of the teeth, but they still exist as conical structures, and the arch form is influenced by the shape of the tongue, not by the teeth.

Figure 7 shows another extreme condition which we find in rodents. This is a rabbit. The molars and premolars are located back at the anterior end of the zygomatic arch. Then there has been extreme development in the anterior portion of the premaxillary bones until the incisors are set far forward. There has been an increase in length. The form of the tooth, not the dimensions of the tooth, has been to a great extent responsible for the shape in the arch, plus the function to which these teeth have been subjected. These teeth all grow from persistent germs, and consequently, if you take a radiogram of them you will find the roots of the upper central incisors have extended far back into the premaxillary bone which has elongated to accommodate them.

Leaving the incisors, we find not only tooth form is responsible for the shape of the arch, but it has been responsible for the special development of bone in the zygomatic cavity. You will notice that the zygomatic and orbital cavity are one common cavity (Fig. 8). There is a special development of bone which shows not only that the tooth form is responsible for the arch form, but that the extra development of bone to cover the end of the tooth is the result of form and function.

If you had the teeth of a rabbit and measured them, I do not think you would be able to make an arch anything like a rabbit's unless you had previously seen the rabbit.

Figure 9 is a radiogram of a squirrel, and the shape of the teeth influences the entire shape of the mandible. The tooth form determines the shape of the arch and the arch is not determined by the mesio-distal diameter of the tooth.

Coming to the herbivorous animals we will find the same thing is true. Function has made necessary the increase in the length of the mandible as well as in the premaxillary bones, on account of the use of certain classes of food. The width of the lower incisor again has nothing to do with the width of the molars. There is no relation that we can figure out. The shape of the arch has been dependent upon the shape of the teeth. The proximal contact has been so arranged that the teeth can perform the function of grinding. The upper teeth approximate or overlap each other on one side, and on the opposite side give support in the act of mastication.

Fig. 8.

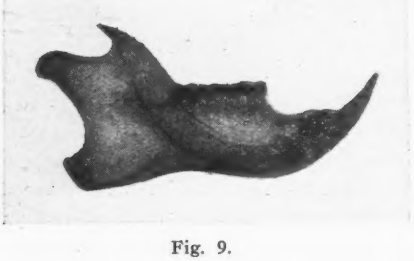


Fig. 9.

Figure 10 shows that arrangement better. See how these teeth approximate on the buccal side and the lower approximate on the lingual side. The shape and function of the teeth have determined this, and the relation between the molars and incisors has nothing to do with the width whatsoever.

When we come to carnivorous animals we will find them to have passed through a series of evolutions. The carnivorous animal, owing to the shape of the canine, develops a different shaped mandible than other animals, proving the influence of the shape of the teeth not only acts upon the arch form but upon the muscles of mastication and the temporo-mandibular articulation.

There is very little else to say regarding the carnivorous animal except the small incisor which you see in Fig. 11. The very small diameter has nothing to do with the

width across the molars. There is no relation existing between the incisors and premolars mesio-distally which can be worked out as a law as you go from one class to the other, but we find tooth form controlled by function has been responsible for the development of the dental apparatus.

When we come to the kangaroo we will find another animal which destroys the whole scheme of mesio-distally measurement of the diameter of the teeth, because in the mandible we have two long incisor roots which extend anteriorly. The upper three incisors develop so that they occlude around the two lower ones and give an effective incising apparatus, and the molars and premolars have been shaped to perform the grinding

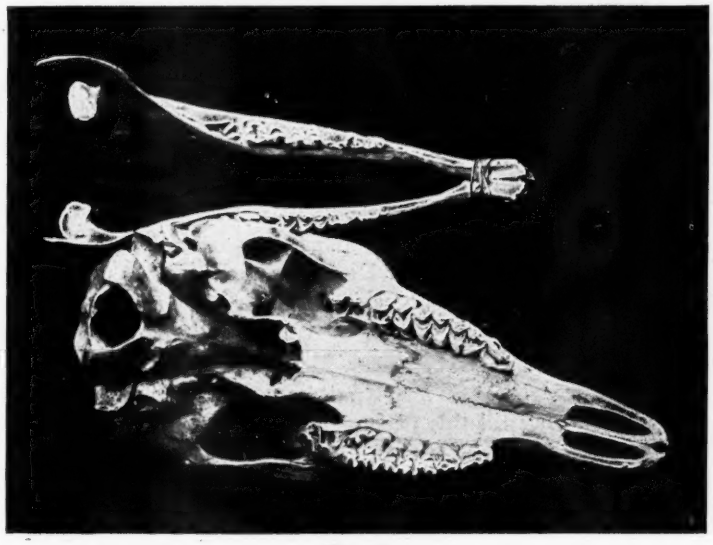


Fig. 10.

Fig. 11.

of the herbivorous diet, but the width of the arch depends upon the shape of the tooth and not upon the diameter of it.

Going back to the primates because Dr. Hellman has shown a large number of them, you will find you can not take any of the primates and construct a dental arch according to the prearranged plan worked out by several men. We have no established relations between the incisors and the width of the molar region.

Another thing which Dr. Lischer mentioned this morning in his paper was alluded to in a paper by Dr. Leon Williams a few years ago in which he claimed a relation existing

between the curve of the zygomatic arch and the curve of the molar and premolar regions. Probably he arrived at that conclusion the same as some have arrived at the conclusion that there is a certain relation existing between the width of the incisors and molars. He saw a few human skulls, and those few he saw happened to have the same curvature; but if there was any relation between the shape of the dental arch and the zygomatic arch in man, it would be the same in primates and other animals. We find in some a straight dental arch and quite a curve to the zygomatic arch. The reason the zygomatic arch takes that curve is that there is a great pull upon it by the muscles of mastication. If I showed you a rodent, you would find the zygomatic arch has a distinct shape because of the peculiar pull of the muscles of mastication. If you apply the same rules to the incisors and measure them with the molars, you would be away off.

Any rule which is carried out in man which does not hold true in the lower animals must be faulty, and the dimensions of the arch and the shape of the arch depend upon the shape of the teeth, and there is no correlation existing between the width of the incisors and the width across the molar region. There is practically no relation between the mesio-distal diameter of the incisors and molars, but it is the form and shape of the teeth, especially the shape of the dental arch, and not only the crown part, but the root, which play a great part as you have seen in our studies of the rodents.

Dr. Milo Hellman, New York City.—I intended to offer my apology for not having sent copies of my manuscript either to Dr. Dewey or to Dr. Bradley, and I do so now, as I realize they were at a great disadvantage in discussing the paper. I did not have my manuscript in a condition to furnish them with copies of it before presenting it to you.

Dr. S. W. Bradley, Ottawa, Canada.—Dr. Hellman need not apologize for not sending me a copy of his paper because I am quite sure if he had done so I would have failed to appear at the meeting till this paper had been read and discussed by other members. It is a timely paper, because I think some of us were being bothered a good deal by those papers of Mr. Stanton and those engineers who are trying to correct teeth according to mathematical formulæ. I started to read some of those papers, and when it came to the formulæ I stopped. I never did like algebraic formulæ anyway, and I gave the engineering principle up, and decided to do as well as I could without it.

Dr. Hellman's paper shows, I think, there is nothing constant in nature. We can not start along mathematical lines. I believe if the form and shape of the teeth are due to heredity, the shape of the arch is due to function and to nutrition.

I heard a splendid paper not long ago by Major Wells who is attached to the Canadian Army Dental Corps. He did a good deal of research work along the line of infant feeding and nutrition, and claimed that mother's milk was the only natural food for infants, and that these so-called artificial foods were a delusion and a snare. While the child seemed to develop from them and to grow, there was a tendency towards the development of rickets; nevertheless a great many children were brought up on artificial foods. He said the nearest food to mother's milk was warm cow's milk diluted and sweetened, and that is very hard to procure unless one lived on a farm.

He also performed some experiments with guinea pigs to show the effect of malnutrition on the teeth and surrounding tissues. He took a number of guinea pigs which were all healthy, and he killed one of them and made microscopic sections of the teeth in the jaw. He showed those teeth the night he read his paper to the members of the Ottawa Dental Society. Then he took some of the animals—I don't remember how many—and put them in boxes where they did not receive sufficient air or proper food for a time, and at the end of three weeks he killed some of these animals and made microscopic sections of their teeth and of the jaw, and these sections showed that the cancellous structure of the bone was not good at all, and showed further that the composition of the teeth had deteriorated. Then he took some of the animals that were ill-fed and ill-housed and put them back into sunlight; took proper care of them, and fed them on proper food and at the end of three weeks killed some of these, made sections of their teeth and the alveolar process and the result showed that the animals were as healthy as they were at the beginning of the period when they were badly housed and fed. Those experiments showed

very plainly that nutrition is the principal factor in developing bony tissue including the maxillary and mandibular processes.

There is one other point, I wish to speak of, and that is, in our practical work in connection with the cases that come to our office we can not go altogether by the form and shape of the teeth in predetermining the arch. We have to judge a great deal by the child's parents. If we could see those parents and then apply our observations to the patient we are to treat, we can doubtless learn a great deal. If we expect a patient to grow to be a tall person from the appearance of the child's parents we will have to shape our arch differently than if we expected the patient to be a square, stout person.

I finished two cases just recently, and one of them was a boy who was stout and squarely built, and his arches are a great deal wider and squarer than those of the other boy who was tall and thin. I do not think it would have been possible to have applied the rules of mathematics to these two cases, for the shapes and sizes of the teeth were very similar. I predetermined my arches from the appearance of the children's parents.

Dr. Hellman (closing).—I have nothing to add in addition to what I have already said other than to thank you for your kind indulgence in listening so attentively to my lengthy paper.

THE CORRELATION OF RHINOLOGY AND ORTHODONTIA*

By E. W. Alexander, M.D., San Francisco, Cal.

FOR years I have been particularly interested in the correlation of systemic diseases with those of ophthalmology and rhinology. It has been interesting to observe that one of the really noteworthy features of the advance in the art of healing has been the organization of the so-called "Diagnostic Sections." This assembling of a number of specialists, covering the entire subject of medicine and surgery, for the consideration of cases submitted to them, with the idea that such a group, working together in a sympathetic way, doing their work preferably in a well-equipped hospital, will be able to add greatly to expeditious, accurate, and inexpensive diagnosis. The best known example of such a group is the Mayo brothers' organization but others are rapidly being formed throughout the country, and we have a very efficient one here in San Francisco. The benefit of such grouping is not all on the side of the patient, but is shared, in a very positive way, by the individuals composing the section, inasmuch as the knowledge gained in the correlation of signs and symptoms of the whole body with their own specialty greatly adds to the efficiency, comprehensiveness, and pleasure of their work.

So, at the outset, I bring to you my main contribution: propagate individually and collectively this association with general medicine, and by so doing establish a point of view which will lead to a greatly improved orthodontia.

The earliest development along these lines between the rhinologist and orthodontist naturally brought out certain mechanical problems. These you are well acquainted with, particularly the vicious circle of septal deviations, adenoids, tonsils and the high narrow arch. We all can call to mind striking examples of improvement of symptoms by breaking this chain of pathologic conditions.

Rhinology has now become a surgical specialty. The days of the "squirt gun specialist" are over. We have come to a situation where we can, in a large percentage of our cases, quickly decide, with the aid of the x-ray, what needs to be done for the alleviation of obstructions to nasal breathing or the eradication of infectious foci in the nose, sinuses, nasopharynx or throat; viz., surgery.

Too great enthusiasm in giving prognosis may lead the rhinologist to bitter disappointment with his operative work, however, if he has not taken into consideration the manifold reflex and systemic affections which have such a marked bearing on the physiology of the nose; and quite conspicuous among these is malocclusion of the teeth and poor and incorrect alveolar arch formation. Here we need your help, and I am afraid it will need some high explosives to drive the idea into some of our skulls.

On the other hand, there are certain practical points in our work which need constant reiteration for the orthodontist. A few of these are: *First.* The necessity of the correction of marked nasal deformity coincident with the use of appliances for widening the narrow arch. One can not, for instance, expect

*Read before the Sixth Annual Meeting of the Pacific Coast Society of Orthodontists, San Francisco, Cal., May 13, 1919.

to correct a traumatic or developmental deviation of the septum, except in selected cases, by any procedure short of surgery. I imagine that if a septum is deviated by the upward growth of the maxilla as it forms the gothic arch, then it will, after its complete ossification in its pathologic shape, associated with spur formation, etc., act as a mechanical hindrance to your efforts to widen the arch because it will hold up the peak. This is particularly true in adults or young adults. Therefore it would seem rational in all such cases to first do a submucous resection of the cartilaginous and bony parts of the septum—this ought to be done in all such cases anyway as a cure of obstruction to breathing and as a preventive measure against sinus disease. Then the application of appliances will be unattended with opposing forces from above; and probably more permanent results will be derived from your work. Furthermore without the free passage of air, the health of the patient is impaired, and so, indirectly, the general and bony development.

Second. A still more important point is the absorption and swallowing of chronic pus discharge from the nasal accessory sinuses. Not infrequently parents of apparently healthy children will allow a serious sinusitis to develop, or an atrophic rhinitis, or one or more of the many pathologic conditions of a systemic nature, dismissing the symptoms with the explanation that "it is just one cold after another." The public is slowly being educated along these lines, and many now know how important it is to stop these infections before irreparable damage has been done. It is the duty of the orthodontist in charge of cases of chronic discharges from the nose, offensive odor of the breath, obstruction to nasal breathing, inflammation and hypertrophy of the tonsils or any nasopharyngeal disturbance of chronic nature, to call to the patient's or parents' attention the necessity of eradicating the menace to the general health, just as it is the duty of the ophthalmologist to insist on physical examination and treatment when he discovers unmistakable signs of high blood pressure or diabetes or any other systemic disease in the retina. Furthermore, I often wonder what the result must be in the production of pyorrhea and erosion and caries of the teeth by the presence of pus in the mouth which has come from the nose or nasopharynx, especially when mechanical appliances are being worn.

Third. Of particular interest to the rhinologist is the influence of perverted secretions from the endocrine or ductless glands on the nasal mucosa. It is well established, for instance, that administration of pituitary gland extract will clear up certain marked vasomotor disturbances, as illustrated by hay fever.

The association of these glands to the development of the individual and especially of the bones is well known, and it seems possible that by the administration of small doses, positive changes in the growth of the alveolar arch and dental structure might be attained, at any rate in an indirect way. Thus in cases which come under your observation where there is a tendency to the vasomotor disturbances in the nose, particularly if there is an apparent delay in the skeleton development and with other signs of glandular disturbance, it would be a good idea to have first a rhinologic examination to rule out local pathology, and then a careful consideration of signs and symptoms of deficient endocrine glandular secretion by an internist, with the idea of supplying the required

stimulus to the glands or of administering an extract of the glands to supplement their activity.

This is one of the most spectacular chapters of medicine and might be turned to good advantage by the orthodontist.

Fourth. A similar, and perhaps even more subtle, problem to us is the intense perversion of the physiologic action of the nose due to reflex action from more or less distant foci of infection and irritation. In this classification large numbers of cases of pathologic dentition undoubtedly fall; also it is almost impossible to differentiate between pain due to mechanical and infectious processes in the nose and that due to reflex causes incident to dentition. It is just here that we need your help for diagnosis and treatment.

In conclusion it must be said that no diagnostic section could be complete without an orthodontist, and that the orthodontist will find that the correlation of his specialty with general medicine will be the means of transforming his point of view most advantageously.

DISCUSSION

Dr. B. Frank Gray, San Francisco, Cal.—Dr. Alexander's plea that orthodontists cultivate an association with general medicine in the hope of establishing a point of view that may lead to an improvement in our work is interesting and is so logical that I am sure he will find most of the men of our specialty in agreement with him. We have, in fact, endeavored to do this for a good many years.

Nasal occlusion, with the coincident mouth breathing, has seemed a stumbling block to the orthodontist, and he has, of course, turned to the rhinologist for help. Beyond doubt the needed assistance has come at times, wholly or in part, but the number of cases wherein it has been long delayed, if not entirely lacking, has been conspicuous. Long since I came to the conclusion that although good, clean work was done by the rhinologist in the removal of so-called "adenoids" or in other surgical procedures, with the hope of restoring the normal respiratory functions, the results were uncertain. In other words our little patients continued their mouth breathing in spite of the best efforts of both the rhinologist and the orthodontists. Therefore it has seemed to me that "habit" plays a large part in the case. Even though ample space was made for the passage of air as in normal respiration, the perversion of function had become so thoroughly established through mechanical obstruction that mouth-breathing had finally become habitual.

So I have come to the point where I very often recognize it as a habit, having no existing pathologic cause. Proceeding upon this basis (which I believe is recognized as correct by the rhinologist), I have sought methods of correcting the mouth-breathing habit. Whether it be a bandage to hold the mouth closed, surgeon's plaster, or other devices, I do not know that any marked success has been achieved. Doubtless as the years go by and maturity is reached the force of the habit will have been spent, so will the good, corrective work in orthodontia have been irreparably damaged.

As to the influence of orthodontic treatment upon the development of the nose and accessory sinuses, it has been generally believed that this treatment justified itself. Because of the intimate relation of the nose and sinuses, the maxillary bones, alveolar process, and teeth, it would seem to require no argument to justify the expectation of benefits to be derived through the harmonious development of all these different parts. But if our hopes would not be disappointed, it would seem necessary that all such procedures de done during the developmental period of a child's life.

The doctor has suggested the operation on deviated septa due to the upward growth of the maxilla and which may be "a mechanical hindrance in widening the arch as it will 'hold up the peak.'" He believes this to be especially true of adults or young adults. Of course, we can move the teeth at practically any period of life, but we have learned enough to know it is a rather hazardous undertaking after the formative period is passed. It is

a matter of retention! There is little use undertaking a long and difficult operation unless we are reasonably sure of permanency of result.

As to glandular insufficiency, while the literature brings the subject frequently to our attention, I prefer it be discussed by those more informed than myself.

No doubt, sinus troubles are overlooked, as Dr. Alexander suggests. It would be indeed well if we were wholly alive to the diagnosis in such cases. Reference was made to the "perversion of physiologic action of the nose due to reflex action and distant foci of infection and irritation." And there was the further suggestion as to whether pathologic dentition may be due to this. It would appear there is ample field for study and investigation along these lines. Doubtless there has been too little done so far from which to form more than an opinion.

Dr. Alexander has paid more than usual attention to the work of the orthodontist I feel sure.

Dr. Allen E. Scott, San Francisco, Cal.—It was my pleasure to have a rather interesting experience along this line some years ago, although I did not get anything very positive and satisfying out of it. Dr. Bogue, of New York, advocates rapid expansion in certain cases. Having a case which I thought required fairly good expansion I placed an ordinary jackscrew across the mouth, and proceeded to apply pressure as fast as was consistent with the comfort and convenience of the patient. I took x-rays at the beginning and each week thereafter. In about six weeks or two months I had expanded the arch from one-half to five-eighths of an inch.

What I wished to determine was whether I was separating the superior maxillæ at the median line or merely producing bone growth. So far as I was able to determine there was no separation at the median line, but a generation of bone even at this extraordinarily fast rate of expansion. Dr. Stanton has taken a green skull and placed an enormous pressure on the arches and claims to have obtained no perceptible expansion. These facts I think have some bearing on Dr. Alexander's remarks.

Mouth-breathing, as I understand it, may be divided into two classes. We have those patients who breathe through the mouth as a result of the physical blocking of either the nose or pharynx, and those who are able to breathe through the nose, but breathe through the mouth simply as a habit. Mouth-breathing in some cases is not a habit. It often happens that it is a physical impossibility to breathe any other way than through the mouth. In my opinion I think that treatment of such cases should not be undertaken until the child can at least force air through the nostrils, which, of course. will seldom take place before surgical interference. I think most of us are inclined to attribute too much mouth-breathing to habit, and not enough to the physical blocking of the upper part of the respiratory tract.

Dr. Robert Dunn, San Francisco, Cal.—I do not believe that mouth-breathing and malocclusion of the teeth, where associated, is due in all cases to pathologic conditions of the nose and throat. In fact, I am of the opinion that in a large percentage of Class II and III cases, the primary cause will be found somewhere else, and that the pathologic condition of the nose and throat present is a resultant condition which, during the development of the malocclusion of the teeth, may be considered a contributing factor in intensifying it. We can not, therefore, in many cases look upon it as a primary cause. I think I can safely say that this question is definitely settled in the minds of the older students of orthodontia.

Dr. Alexander.—(closing discussion).—The question of mouth-breathing is a very complex one, inasmuch as it is associated with such subtle influences. Local pathologic conditions have been spoken of. Habit has been suggested, and to overcome habit great patience is required along the lines of suggestion, but it can also be remedied by courses of physical training and singing exercises. On the other hand, in some cases turgescence of the nasal mucosa, without mechanical deformity, blocks the nose, and is due to depletion of the nervous system incident to a general debility, or to disturbances of the function of the internal secretory glands, or to a neurosis of hereditary character.

Finally it must be said that, while each of our specialties can control local conditions in a majority of cases, there are not infrequent examples of cases where results are nil until the broader aspect of metabolism, nerve reflex, etc., is brought to bear.

HISTORY OF ORTHODONTIA

(Continued from page 527, Vol. V.)

By Bernhard Wolf Weinberger, D.D.S., New York City

DR. ANGLE, in his first Presidential Address before the American Society of Orthodontists, speaking of *"Orthodontia as a Separate Science"* stated:—"It is that orthodontia is a great science by itself, with requirements in its study and practice so radically unlike that of other branches of dentistry that the two can never be profitably combined, either in study or practice. Each seriously handicaps the other and orthodontia naturally suffers most for the reason that it is wholly unlike other operations in dentistry. It is therefore least understood, least studied, and made secondary alike in dental colleges, in practice and in dental societies. Hence it is not unlikely to follow that in proportion as a dentist is successful in other operations of dentistry he will naturally be less successful in those of orthodontia, for in that same proportion he will have less inclination, less time, and less energy to devote to it. Few would think it advisable to combine the practice of rhinology with that of dentistry, and yet we believe the two could be far more easily, profitably and successfully combined than can orthodontia and dentistry proper. The fact is, orthodontia deals almost wholly with different tissues, principles and art problems from those treated in ordinary dentistry and is extremely exacting in its requirements, necessitating peculiar talent, energy, fitness and devotion to certain lines of study which are as unlike those of other branches of dentistry as are the instruments best adapted to the performance of operations in each.

"Another most important reason is that the science of dentistry has grown to such proportions as to embrace in its study so large a field that any one who attempts to master it all must be regarded as a mere smatterer. In fact it needs no argument to prove that all progress in the different branches of dentistry is in reality being made largely by those who are specializing.

"The ultimate separation of orthodontia from dentistry proper is natural and inevitable and the sooner it is encouraged and becomes firmly established, the better it will be for both and indefinitely better for humanity at large. Orthodontia offers ample opportunities for the brightest minds. Let each student of dentistry, after having acquired a thorough knowledge of the fundamental principles of the science, select such lines as are best suited to his aptitude and liking and confine his energies to his selection and the result can not fail to be vastly more beneficial than the plan now followed. As yet there have been only a few men who have had the courage to completely specialize the practice of orthodontia, but the results of the efforts of even those few have been truly remarkable. Orthodontia has been revolutionized, and we would ask those who may doubt the practicability of this specialization of orthodontia to but reflect on the marvelous advancement which has been made in the various branches of medicine through specialization, not to mention the growth of nearly every other branch of science and art accomplished by the same power. Indeed this is the very age of specialization, and was there ever such an age of progress? Wise is he who

recognizes the natural and resistless power of specialization, and narrow indeed must he be who is blind to its demands and attempts to resist its might.

"To hope that all this may be brought about at once, or even in several years, would be expecting too much. Great and radical changes must be wrought slowly. We must remember that each specialty in medicine has developed slowly and has become firmly established only after a considerable lapse of time and after many trials—ofttimes in spite of the keenest opposition—yet we can point with pride to the career of the late *Dr. Thomas Rumbold* of this city, whom several of us were proud to have the honor of calling friend. He was the father of rhinology and lived to see it firmly established as an indispensable specialty in medicine."

"Some Basic Principles in Orthodontia," International Dental Journal, page 729, 1903.

"I shall try this evening to make clear some principles which seem to me basic, and on the intelligent comprehension and application of which depend the possibilities of successful achievement.

"First, I shall hope to demonstrate to you that we must consider the dental apparatus as a whole in each case, together with the throat and nose and facial lines, instead of limiting our attention to local symptoms in the form of one or more crooked teeth, as has long been the practice.

"Secondly, I shall try to impress you from the orthodontist's standpoint, with the value of each individual tooth and with the absolute necessity of preserving the full complement of teeth, or its equivalent, in every case. I shall try to bring conclusive evidence that the sacrifice of teeth for either the intended prevention or correction of malocclusion is not only wrong practice and fallacious teaching, but most baneful in its results. I shall further try to show that the full complement of teeth is necessary to establish the most pleasing harmony of the facial lines.

"Thirdly, I shall try to prove to you that the first molars are the most important of the teeth, and that they are the first to be considered, from the orthodontist's standpoint, in both diagnosis and treatment; that we must first look to their correct adjustment instead of beginning with the incisors and ignoring the positions of the molars, or attempting to correct them last.

"Fourthly, it is positively essential that each arch and the teeth of each arch shall receive at least equal care in their adjustment, the preference, if any, being given to the lower.

"And lastly, I shall try to show you that fully ninety per cent of the regulating appliances represented in our literature are constructed and operated upon incorrect principles.

"I shall not have time to touch upon the etiology of malocclusion, but I feel that I should not miss this opportunity to say that I believe it is as ignorant as it is cruel to brand as degenerates those suffering from malocclusion of the teeth.

"I hope I shall this evening awaken much interest, and if we do not agree on some points it will not be the first time that men have differed on the subject of orthodontia, yet I hope and believe that our differences will be honest.

"Normal occlusion is maintained only through the normal relations of the

inclined planes of the cusps, assisted by the normal influence of the muscles externally and internally upon the crowns of the teeth.

"There are two points of great importance in the occlusion that I also wish you to remember. First, the normal relations of the first molars, and second, that of the cuspids. The first determines the mesio-distal relations of both lateral halves of the arches; the second, the width of the arches. If the first molars lock normally, as you see in this picture, the mesio-buccal cusp of the upper will occlude in the buccal groove between the mesio- and disto-buccal cusps of the lower. And if the first molars are so locked in their eruption it will make possible the normal eruption of all the teeth both anterior and posterior to them, as has resulted and is here shown in this beautiful picture. But if the first molars lock mesially to normal, or distally to normal, in their eruption, it will necessitate the eruption into positions of malocclusion of all the remaining teeth both anterior and posterior to them, and according as these molars erupt and lock in mesial or distal relations, in one of the lateral halves of the arches, or both, will be determined certain classes of malocclusion which will be considered later.

"Now, if the locking of these molars plays so important a part in the eruption and positions of the remaining teeth, can you not see how important it is that they be preserved and early attention given to their eruption and relations? Hence the time for beginning treatment of malocclusion is no longer mythical, but as fixed and well-defined as the first molars themselves.

"It must be borne in mind, however, that even with the normal locking of the first molars and normal mesio-distal relations of the jaws and arches, the normal locking of all the other teeth is by no means assured, and malocclusion may involve any or all of the teeth anterior to them, but usually is chiefly confined to the narrowing of the arches in the region of the cuspid, with bunching of the incisors, similar to the case first illustrated, and, as we have said, by far the largest number of cases of malocclusion belong to this class, and it is to this great class we will first direct our attention.

"Before leaving this picture let me try to impress you with the importance and wonderful relations of the occlusal planes, how they must gain their normal relations if we would hope to be successful in maintaining them in the positions in which we wish them to remain after correction. And what a waste of time to consider one arch without the other, or to attempt to ignore the importance that each tooth bears to all other teeth in both arches. Or, in other words, this picture of normal occlusion and all that it means must actuate and direct all of our efforts from the beginning of treatment to the termination of retention.

"In the treatment of these cases I believe I can again prove to you that my theory is correct, that extraction is wrong, that the full complement of the teeth is necessary to the best results, and that each tooth shall be made to assume its correct relation with its fellows. In other words, if the molars and premolars of the upper dental arch be moved distally one-half the width of the cusp of a molar, or premolars of the lower arch be tipped forward in their alveoli to the same extent, or one-half the width of a cusp of a molar or premolar, there will then be normal mesio-distal relations of these teeth, and if the arches in the region of the incisors be put in true at the same time, there will be harmony in their

relations and the best effect will have been produced upon the facial lines. In other words, we will have established normal occlusion with all its possible benefits.

"This plan of treatment I have been practising now but three years, and so pleased am I with it in the large number of cases that I have so treated that I no longer practise or believe in the plans that I formerly advocated, or that of gaining harmony in the sizes of the arches by the sacrifice of the two first premolars in the upper arch and retracting the cuspids and incisors to close the spaces, or by the plan known as 'jumping the bite,' first advocated by my friend, *Dr. Kingsley,* consisting of first placing the teeth of each arch in correct alignment and then compelling closure of the mandible forward the width of one premolar tooth on each side, so that all of the teeth were in normal occlusion. That both of these plans may have been more or less successfully followed there can be no doubt, but I believe them to be far more tedious, more difficult of accomplishment, and more uncertain as to satisfactory results than the plan I now follow.

"Now, as to treatment. The upper molars and premolars were moved distally and the lowers mesially until they were in normal occlusion, as shown in the next picture. You will see that each occlusal plane is in normal relation with its opposing occlusal plane, thus locking and assisting in its retention, and I assure you that the facial lines were as greatly improved as was the occlusion.

"And how was this accomplished? you will naturally ask, for you must justly reason that to move all of the teeth in both arches, as has been done, certainly would require a considerable degree of force, and that it should be directed in the right direction.

"I formerly advocated a few combinations of appliances which I have now largely abandoned. I believe the headgear and chin retractor were valuable. The latter is now entirely obsolete in my practice and the former but rarely used, and the same might be said of the traction screw and rotating levers. The jackscrew has been and doubtless will long continue to be the one form of regulating appliance most used by dentists, for it seems almost impossible to get dentists to study occlusion, its bearing upon and importance to orthodontia, but they can and do reason only from the basis of the mere symptoms, or 'crooked teeth,' as they call them, and they naturally reason that a jackscrew placed against a tooth that seems to be 'straight' and made to operate at its other end against one that is 'crooked,' to push it into a better position, is the one thing needful, but I believe the jackscrew to be one of the poorest of regulating appliances, and I say this notwithstanding that I am the inventor of what I believe to be the most simple and efficient one yet brought out, and one that has more base imitations than any other of my inventions. But I now think the principle is wrong with the jackscrew, as it is with all these forms of appliances that are made to act locally, so to speak, or upon only the teeth that seem 'crooked,' instead of one that should become operative from the basis of occlusion, having control of one or of all the teeth of not only one but of both arches, if need be. I can not bring out the point too forcibly that it should be our mission to improve the dental apparatus as a whole through occlusion, for in this way only can our efforts be fruitful of the best results in not only bettering the principal function of the teeth,—

mastication,—but their appearance, as well as giving greater freedom to the movements of the tongue, and also making possible the modification of the vault of the arch towards the more normal growth and development of the nasal tract, and last, but of great importance, a better contour of the face with more pleasing lines of facial expression.

"I am now accomplishing fully 98 per cent of the tooth movements in my practice with but a single appliance, and performing them far easier and more quickly than I ever did with all the various combinations I have ever advocated in the past, which at most were only very few, for it has ever been my aim to simplify both the diagnosis and treatment of cases in my practice, and all of the cases you will see on this screen tonight have been treated with but one appliance, —namely, the expansion arch,—and although I believe that I have added some valuable improvements to it, yet it was known and used before this Republic was. It was first used by that greatest of the early dentists, the Frenchman *Fauchard.*

"The next picture (Fig. 30) [Fig. 1] shows it as I now use it. In temper it contains much spring, sufficient to speedily widen the dental arch, if need be, and having self-locking nuts to properly adjust it to the demands of expansion. It is

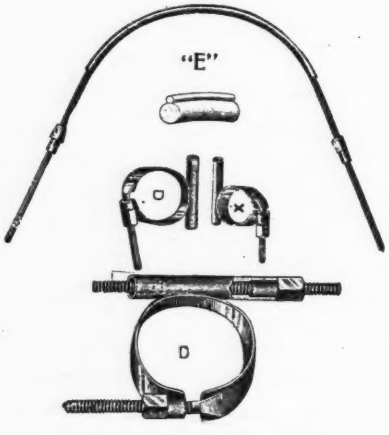


Fig. 1.

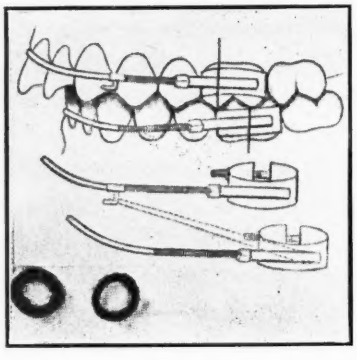


Fig. 2.

round instead of being half-round or flat, as used by the older writers, which better prevents the accumulation of food, as well as making it more compact and less conspicuous. My latest improvement to it is a delicate rib on the periphery of the inthreaded portion. This is to be notched at desired points to prevent the slipping of wire ligatures, this form of ligature being not only a very valuable addition to orthodontia, but making this wonderful appliance vastly more efficient. I have called it wonderful, and truly it is, and he who intelligently experiments with it will grow daily more and more impressed with its great possibilities in correcting malocclusion. In my opinion there is no tooth movement, be it simple or complicated, that can not be performed more quickly and easily with this than with any other device, and I have arrived at this conclusion not hastily, but gradually, and one by one have abandoned nearly all of the other once favored appliances.

"I wish we might spend much more time on this picture, but I have carefully described it in other writings, and must hasten to other pictures, only

stopping here to say that in all cases belonging to the first class, if we have used this appliance intelligently and have adjusted each tooth in each arch, the arches and the occlusal planes will then be in harmony, and if the teeth are in distal occlusion, as in the case considered but a few moments ago, the lower teeth may be easily shifted mesially and the upper teeth distally into harmony of occlusion, it only being necessary to use two of the expansion arches, and reciprocating the force from one to another, as shown in the next picture (Fig. 31) [Fig. 2], the force being derived from one or more delicate rubber ligatures made to engage the distal ends of the tubes of the bands on the anchor teeth of the lower arch, and sheath-hooks which have been attached at desired points to the upper expansion arch. By studying this picture carefully you will see that force is exerted in the exact direction it is needed, and at the same time most inconspicuously and with very little inconvenience to the patient.

"Now, I know that when anything new and valuable is brought out in dentistry there is usually that familiar type of individual who will rise up and say, 'Why, I have been using that for twenty-five years,' but to my mind this savors of 'degeneracy.' The fact is, to the best of my knowledge and belief we are indebted to *Dr. H. A. Baker*[1] of Boston, for this idea, he having used it in the retraction of the protruding incisors of his son a number of years ago, and it was from him I received the idea. I have hence called it the *'Baker Anchorage,'* and it has almost revolutionized my daily practice. In its use, however, I would add this important improvement,—that the force be directed upon the molars first, instead of on the incisors, their positions being, as I believe, merely the result of the malpositions of the molars, and we should unravel the complexities of these cases by beginning right, that is, with the molars, following with the premolars, and lastly adjusting the incisors. And using it as here shown the force is directly received upon the first molars, pushing the upper distally and pulling the lowers mesially. Of course, all the lower teeth, as here shown, will be carried forward, and all the force required in their movement will be pitted against the upper first molars. As these move distally (the nuts being occasionally tightened), more or less space will be noted between them and the second premolars, and after the molars have been carried well back into correct positions the anchor bands should be removed and similar smaller bands (X-bands) placed upon the second premolars and the expansion arch again applied. Wire ligatures are also made to engage both first and second premolars on each side, and force from the rubber ligatures again exerted. After the premolars are well back into position the nuts in front of the tubes on the anchor teeth are loosened, or removed entirely, allowing the force of the rubber ligatures to be received upon the incisors through the centre of the arch. In this way the incisors, if they be prominent, are soon retracted.

"Of course, it is of the utmost importance that the teeth shall be mechanically retained in their new positions. The real retaining devices are the inclined occlusal planes, but these must be assisted for a time by a mechanical device, or of course the teeth that have been moved will speedily revert to their original

[1]Since giving the above address I have learned that *Dr. Calvin S. Case,* of Chicago, also employed this form of anchorage, probably at about the same time as *Dr. Baker.* It is reported in the *Transactions of the Columbian Dental Congress,* 1903.

positions, and the next picture (Fig. 32) [Fig. 3] will show you a simple device for holding the teeth that have been moved mesially in the upper arch in normal relations. I have been using this with much success for a long time. At first I used a spur cemented into a tooth, but later attached the spurs to accurately fitted clamp-bands, the spur being made to close in front of a metal plane attached to a band upon an opposing tooth, as you now see them. They may be used either upon molars or premolars. The bands must be accurately fitted and carefully cemented, and the plane and spur correctly placed. If this be properly done they will last as long as desired. I have had them remain in position two years without loosening, but unless they are properly adjusted they will give trouble, the one usually giving way being the spurred band.

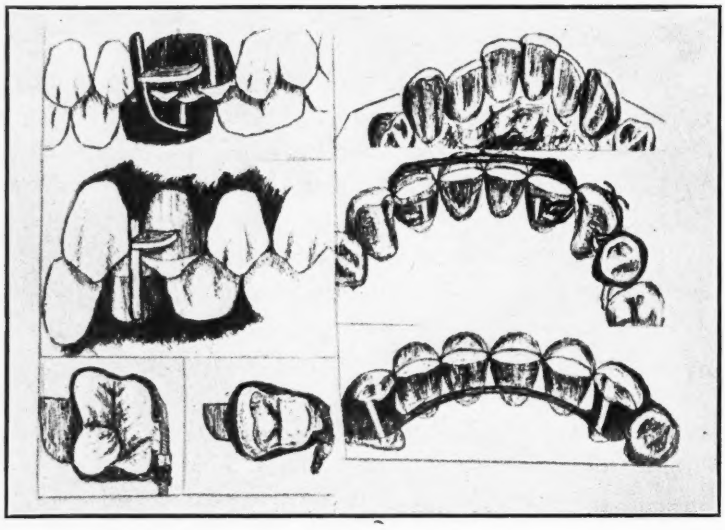


Fig. 3.

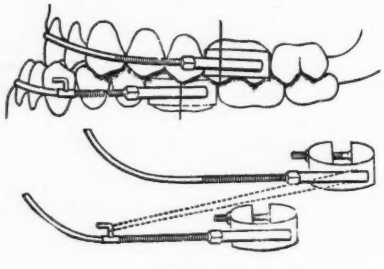


Fig. 4.

"The other devices shown in the cut are for the retention of incisors and cuspids, and are so well known that I will not take up your time here with an explanation of them.

"The plan of treatment was the same as that described for cases belonging to Class 2, only, of course, the direction of force was reversed, as shown in Fig. 33 [Fig. 4].

"In conclusion, let me say I have touched but a few of what seem to me the important places in orthodontia. Each class, division, and subdivision is ample for a full evening's discussion but if I have awakened a higher appreciation of occlusion and convinced you that the first molar tooth is not only first

in importance but first to correct if in malposition, I will have accomplished much but no less than if you have been brought to realize that the hasty, ruthless sacrifice of teeth for the correction or prevention of malocclusion is as barbarous and unscientific as it is disastrous in its results. If I have done this I shall always feel that my mission to this society has been an enjoyable and fruitful one."

Before the Fourth Annual Meeting of the American Society of Orthodontists, 1905, *Dr. Angle* in speaking of the *"Upper First Molar as a Basis of Diagnosis in Orthodontia"* treated the subject of the importance of diagnosis. He states:—

"If, then, diagnosis involves such responsibilities, what extreme care should the orthodontist give to it! How eagerly should he grasp every particle of knowledge that can give him light toward correct, intelligent diagnosis!

"Yet, notwithstanding that we still have 'guessers' and 'guessing' and 'odontocides' linked together, one and inseparable, who juggle terms and meanings and furnish lots of evidence which won't bear sifting to explain the 'guessing,' with carefully devised loopholes as to meanings and dates and assertions, and will doubtless continue to have such with us for a long time to come; yet, I say, notwithstanding all this, we do have a simple principle to guide us to a correct, intelligent decision in diagnosis, which diagnosis is always a sure clue to a correct line of treatment, even to retention. A principle, too, which eliminates 'guessing,' is antipodal to both 'guessers' and 'guessing.' It is a principle, too, so simple that experts are not needed to understand and interpret it, but any sincere student, no matter how humble, with intelligence enough to master the English alphabet can understand this principle and apply it successfully in diagnosis, and this principle applies to every case of malocclusion in existence in a human denture today, or that ever did exist. Indeed, every case of malocclusion carries with it this principle which is a key to its own solution, its correct diagnosis, and that key is the key to occlusion—the first permanent molars, or more particularly, as I shall show you later, the *upper first permanent molars.* I repeat that this key is not for the 'guesser' or the would-be improver of God's laws, but for the student of occlusion—the interpreter of Nature's great law in the human denture.

"To the members of the new school of orthodontia this key is familiar and in daily, yes, hourly, use, and its great value attested, so that to you little need be here said. Yet in connection with it there are some points which I shall present that may be of interest to you, for, recently, in the preparation of the MS. for another edition of my book I have gone over the entire subject of orthodontia, reasoning and weighing as carefully as I could all the points bearing on its various phases, and I believe that I can offer a few additional proofs why the upper first molar is the correct basis for diagnosis.

"Let us study somewhat carefully this kind of teeth which we have designated the 'key of occlusion.' Before the first molar erupts it is preceded by the completed denture of the child, which has developed normally under the most favorable conditions, for the food and habits of the child have been very simple and normal, with practically no pathologic conditions sufficiently grave to prevent Nature from carrying out her plan of the normal in building the denture.

So the deciduous teeth almost always erupt into ideal normal occlusion and the child denture is not only perfect in form, in part and in whole, but in location with the rest of the face and head, so that there is beauty, harmony and the highest efficiency. *Dr. Anema* has well said in conection with this thought, that the reason children's faces are in such perfect balance is because their teeth are in normal occlusion.

"So, when the first molars erupt, they do so under the most favorable conditions, unhampered by predecessors or by those teeth anterior or posterior to them, the jaws having been lengthening for years for their coming, and instead of being in any way hindered in their eruption they are, on the contrary, *guided into and guarded in* normal position by the beautiful, normally built child denture anterior to them.

"The first molars have the largest crowns, best defined cusps, largest roots and strongest attachments to the alveolar process of any of the permanent teeth, and owing to their great size and their position in the jaws they are chief in the function of mastication. As the first molars are planted in the alveolar process long years before the permanent teeth, anterior and posterior, shall take their place in the line of occlusion, they have become very firm of attachment; so by their size and strength they can and do act as dictators of these teeth and indirectly of all the other permanent teeth as they take their respective positions in the line of occlusion at their respective times. They also act as wise ruler, determining by their own length the length of bite, and in this way, in no small degree, decide the length of the face and the art relations, which, in importance, is best illustrated, and in a striking manner, by what the face misses in after years when these teeth are sacrificed, allowing the settling together of the jaws and shortening of the face, with consequent inharmony of facial lines, always so noticeable, and their wise control of the normal mesio-distal relations of the jaws by the locking of their well defined cusps is a factor in the growth and development of the face and jaws of mighty importance.

"Up to the time of the coming of these teeth this important office was performed by the locking of the entire number of deciduous teeth, whose efficiency has been gradually lessened by the wearing away of their cusps and the otherwise weakening of these teeth by the absorption of their roots, but after the eruption of the four first permanent molars they must be not only the principal supports of the jaws and the controller of their lateral as well as mesio-distal relations for years, but on them, also, must fall almost wholly the burden of mastication. I wonder how many of you comprehend and appreciate the important responsibility that the first molars assume in controlling the relation of the jaws, mesially and distally, as well as buccally, which has been transferred to them by the wearing smooth of the cusps of the deciduous teeth. Little indeed can be the assistance given by the permanent incisors during or even after their eruption, toward controlling the normal mesio-distal relations of the jaws, but if out of their normal positions they may and often do act as hindrances instead of helpmeets. Not until long years after the eruption of the first molars do they receive support and assistance from their weaker brothers, the premolars, and not until they have faithfully borne the great burden and responsibility dur-

ing the most trying period in the growth of the denture for six long years do they receive that real support from the second molars which it would seem they have so long needed; but by this time the great structure is practically completed, there only remaining to be added the tardy, erratic and very important last members of the family, the third molars.

"So far in what I have said relating to the first molar, the upper and lower have been regarded as of equal importance, as they should be, for in function of mastication they are equal, as well as in influence upon the rest of the dental apparatus during its growth and development, and they should be of equal importance in diagnosis, *but only when they succeed in locking normally* in their mesiodistal relations. But owing to the fact that the lower molar is dependent upon the caprices of the migratory mandible, it is in consequence less reliable than its sturdy, though somewhat smaller, but far more steadfast antagonist. For this reason the upper first molar becomes the true basis of diagnosis."

In 1908, *Dr. Angle* before the Alumni Society of the Angle School of Orthodontia, brought forward the question of *"Bone Growing" Dental Cosmos,* 1910. In this paper he introduced the *"Working Retainer"* the method that later developed into the *"Pin and Tube Appliance."*

"Doubtless you will be surprised at the title of my paper, and you will ask what *Bone-Growing* has to do with orthodontia. My answer is that it is probably the most important problem in orthodontic treatment. Indeed, most of our successes in treatment depend on our success in bone-growing, and if the orthodontist does not succeed in growing bone he will find, in time, that the teeth he has moved so dextrously and satisfactorily have all returned to, or very nearly to, their original positions. For this reason the branch of science which *Dr. Noyes* teaches us, histology, when it is understood and its relation to orthodontia really comprehended, will probably be accepted as the most important of any subject in the orthodontic curriculum, because it has so largely to do with the science of *Bone-Growing.*

"Let us remember that malocclusion of the teeth is always associated with a lack in the growth of bone, or the perverted growth of bone, in degree corresponding exactly with the degree of malocclusion. Nature attempts to build a denture, a face, a skull, and all other parts of the anatomy to be in accordance throughout with a type she has designed for the individual; but for some reason some of her processes in the building of the different parts may have been interfered with. The result, as we find it, is perversion or arrest in the growth of the alveolar process, jaws, and associate bones, and malocclusion."

THE "WORKING RETAINER"

"With a view of expediting the treatment of malocclusion by shortening the period of retention in these cases, the writer has devised a method of retention by which he believes the cells involved in these tissue changes will be gently stimulated to greater and longer activity, with the more speedy and complete development of the tissues.

"The device has for its purpose not only to support the crowns of the teeth in their corrected relations with the line of occlusion, but at the same time to exert a very gentle but constant force labially on the roots of the incisors. It

may be regarded as a *'Working Retainer,'* as appropriately named by a former student of the writer, *Dr. Geo. B. Palmer.*

"The device is made by removing the segment between the threaded ends of the expansion arch that had been employed in accomplishing the movement of the teeth, and substituting for it a segment, of the same length and curve, of very delicate and elastic irido-platinum and gold wire, twenty-nine thousandths of an inch in diameter, attaching the ends of this wire to the threaded ends of the original arch with twenty-two karat gold solder. Very small tubes are soldered perpendicularly to the labial surfaces of delicate irido-platinum bands previously very carefully fitted to the crowns of the incisors. These tubes must be parallel with each other, their incisal ends resting in contact with the middle segment of the arch.

"Very delicate spurs, of the length and diameter of the bore of the tubes, or twenty-two thousandths of an inch, are soldered to the arch at points opposite the mouths of the tubes when the arch is in position. The ends of the spurs are then gently inclined forward about three thirty-seconds of an inch by bending, the arch replaced upon the teeth, and the spurs sprung into the tubes. Thus a gentle force from the elasticity of the spurs and arch combined is given stationary support in all directions."

Again before the Alumni Society of the Angle School of Orthodontia, September, 1911, *Dr. Angle* gave to orthodontia his method of *"Root Movement of Teeth."*

"Instead of tipping the crowns of the teeth into the line of occlusion and leaving the roots at abnormal angles of inclination, to be adjusted by nature during the period of retention, the teeth should be moved bodily, as a result of force so gentle and so evenly distributed as to stimulate normal cellular activity and the growth of bone." This was known as the *"Pin and Tube Appliance" "Evolution of Orthodontia—Recent Developments, Dental Cosmos, page* 853, *August* 1912."

"BONE-GROWING" AND THE "WORKING RETAINER"

"It then occurred to the writer that the retaining device should, if possible, be so constructed as to operate not only for the support of the crowns of the teeth in their corrected positions, but also to exert gentle pressure outward on their roots, and thus assist nature by stimulating the osseous cellular activity to more rapid, complete, and normal development of the bone.

"The working retainer, which was carefully described and illustrated on page 265 of the March, 1910, issue of the *Dental Cosmos,* and which we would request the reader to review carefully, was the result, and so successful was this method of retention that it has become an accepted practice and is recognized as a factor of much value, as with it far quicker and better results are gained in many cases than were possible before especially, as we have said in the article above referred to, in those cases where the most active period in the development of bone had passed.

"From this step the writer reasoned that our very plan of treatment might be greatly improved; instead of tipping the crowns of the teeth into the line of occlusion and leaving the roots at abnormal angles of inclination, to be adjusted

by nature during the period of retention, the teeth should be moved bodily, *as a result of force so gentle and so evenly distributed as to stimulate normal cellular activity and the growth of bone.* In other words, the work of the orthodontist should be the intelligent assisting of nature in her process of development bone, thus making it possible for her to normally build the denture in its entirety. When the proper assistance has been rendered and the normal growth and development of the bone and other tissues accomplished, all other conditions being favorable, the work of the orthodontist should be at an end, thus eliminating entirely the usual tedious period of retention, with its attendant difficulties and annoyances.

"That tooth movement is performed more easily, more satisfactorily, and with better results when very gentle pressure, rather than pronounced force is employed, has for a number of years been becoming more and more apparent to the writer, and the correctness of this belief has now been abundantly proved by the recent remarkable research work of *Dr. Albin Oppenheim* of Vienna, in his elaborate experiments in moving the teeth of monkeys. These experiments were fully reported in a course of lectures by *Dr. Oppenheim* at the session, just closed, at the Angle School of Orthodontia; a report of these investigations will

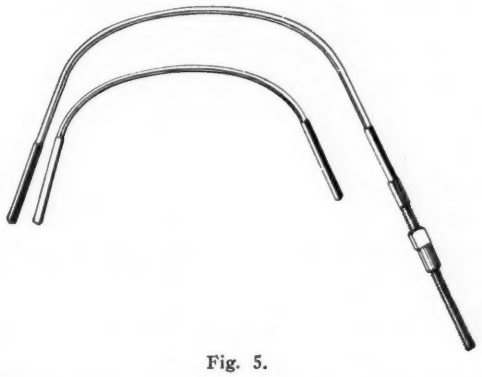


Fig. 5.

soon be published in this country, and should awaken the greatest interest, especially among histologists and orthodontists.

AN IMPROVED FORM OF EXPANSION ARCH

"Experiments made by the writer, covering a period of four years, have resulted in the production of appliances for accomplishing tooth movement in accordance with the plan above suggested. These appliances consist of an expansion arch of further modified form, with auxiliaries and attachments. Fig. 34 [Fig. 5] shows the modified arch. It will be seen that it is divided into three parts, a middle section and two ended sections. The end sections are threaded and provided with friction-sleeve nuts. The middle section is smooth, with square ends, which accurately telescope for a distance of about one-eighth in square sockets in the anterior ends of the threaded sections. One of the advantages of this form of arch is that the middle section may be of any length or diameter desired, and as a result of many measurements of models, three length and three diameters of each length are found to amply provide a most convenient range of size and strength for all dentures, from the smallest to the largest, thus fully meeting all requirements in practice. All middle sections, of whatever length or diameter,

are accurately interchangeable with the threaded sections, which are of the same diameter as the threaded portions of the writer's standard expansion arch E, the friction-sleeve nuts being adapted to the writer's standard D bands.

"The three diameters of the middle section are forty-five thousandths of an inch, thirty-eight thousandths of an inch, and thirty thousandths of an inch (.045", .038" and .030"). The arches of heavier diameters, that is .045" and .038", are intended to be used in connection with wire ligatures in precisely the same way as the standard expansion arch E, which has so long been familiar to all. These heavier middle sections are made in both precious metal and nickel-silver, as are also the threaded sections.

THE .030" DIAMETER ARCH AND ITS APPLICATION

"To those already familiar with the expansion arch E, any further description of the larger diameters of the middle sections of the new arch in regard to their use in connection with the clamp bands, wire ligatures, etc., seems unnecessary; the use of the two forms of appliance and the manner of their operation is identical, but the greater convenience of the new form readily suggests itself. The manner of using the delicate arches of .030" diameter, however, is unique, and the plan of operation radically different from that for the arches of heavier sizes just described, and it is by the use of this delicate arch only that the movement of the teeth bodily, *i.e.*, of the roots as well as the crowns through the stimulation of bone-growth, is possible. It is made of precious metal only, for reasons which will be given later. In its use, wire and all other forms of liga-

Fig. 6.

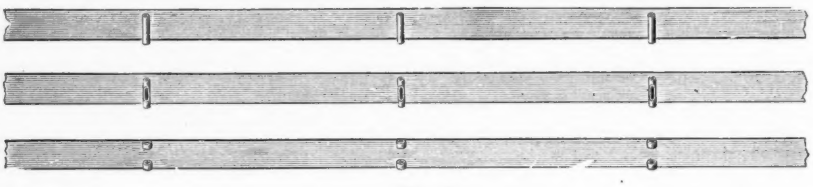


Fig. 7.

ture are dispensed with, the attachments of the arch to the teeth to be moved being accomplished by means of delicate pins (Fig. 35) [Fig. 6] soldered directly to the arch, which engage very delicate tubes (Figs. 35 and 36) [Figs. 6 and 7] soldered to bands upon the teeth to be moved, insuring the most firm and compact attachment with practically no loss of power by stretching or displacement, and with perfect control over the direction and distribution of force, not only upon the crowns of the teeth to be moved, but simultaneously upon their roots as well.

"These very delicate pins, tubes, and arches are carefully proportioned and most accurately made on special machinery. The pins closely telescope the delicate tubes, which are of uniform length, diameter, and bore. One end of the pin is made in the form of a hook, which accurately fits the bevel of the end of the tube when the pin is in place in the tube. It is of the greatest importance that this hook shall not be dulled and thus rendered ineffective. The orthodontist should study its proper locking and unlocking, to avoid injuring it. The other end of the pin has the form of a minute fishtail, with a knife-edge crescent for convenience in attaching the pin to the arch with solder. A portion of the outer

wall of some of the tubes is seen in Fig. 35, to be cut away in crescent form. This is not necessary, but will often serve as a convenience by giving access to the pin for its bending without wholly removing it from the tube.

"Mode of Applying Arch in a Typical Case Belonging to Class 1. In the following we shall describe the adjustment and operation of the new appliance for the treatment of a well-defined, typical case belonging to class 1 (writer's classification), a model of the upper jaw of which is shown in Fig. 37 [Fig. 8]."

It will be impossible to describe the adjustment of the appliance in this history, on account of the length, but by referring to the original article those interested will find a detailed description of same.

On account of certain defects in the handling of his previous appliances *Dr. Angle* before the same Society the next year (1912) described a better method of adjusting the tubes, etc., in order to bring about root movements. *"Further Steps in the Progress of Orthodontia"* in the *Dental Cosmos,* January, 1913.

"At our meeting one year ago, as you will recall, I presented a new plan of treatment of malocclusion of the teeth, with new forms of appliances for accomplishing the various tooth movements in accordance with this plan, a de-

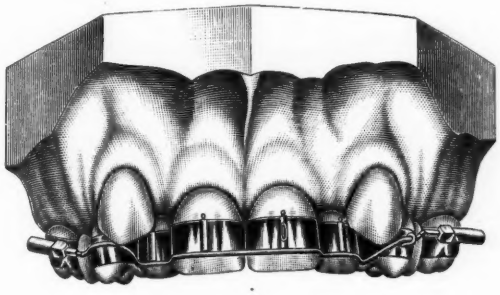


Fig. 8.

scription of which was published in the *Dental Cosmos* for August last. A close study of that description is necessary for a full comprehension of what I shall present today.

"As a result of wider observation, much thought, and careful experimenting, I think I can today not only greatly simplify the technic in the adjustment and operation of the appliances then presented, but lead you to a more intelligent appreciation of the possibilities and advantages to be gained by the employment of the new method of treatment."

Not satisfied with the *"Pin and Tube"* appliance *Dr. Angle* in 1916 introduced *"Some New Forms of Orthodontic Mechanism, and the Reasons for Their Introduction."* [*Dental Cosmos,* September, 1916, p. 969.]

"The introduction of the pin and tube appliances undoubtedly marked a great step forward in orthodontic treatment, for with it was gained not only better control of force for the crown movements of teeth, it was the first practical mechanism for the proper control and distribution of force for the movement of roots of teeth, singly or collectively, and simultaneously with or independently of their crown movements. And, what is of still greater importance, with this mechanism the force for the movements of either crowns or roots can be

applied or controlled in a manner that is far more nearly in accord with the requirements of the physiology of the tissues involved in tooth movement than with any other previously employed. It is well known that more nearly ideal results in occlusion and in bone development, as well as in facial development, have been gained by its use than was ever possible before.

"Its use has become standard with the best orthodontists of this and other countries, and it is of course very gratifying to me to know that my predictions regarding its value have been verified. Yet it is a humiliating fact that many who are attempting the practice of orthodontia seem to be so lacking in judgment and in technical skill as to be unable to gain anything nearly like the measure of success that is possible in the use of this mechanism, or to appreciate the fact that correct forms and proportions and proper material for the construction of the various parts, with accuracy and perfection of workmanship in manufacture, are essential to its proper efficiency. The principal difficulty with most seems to be inability to properly locate the pins and attach them to the metal arch, and many indeed have been the modifications of the mechanism and the substitutes devised in order to overcome this to them insurmountable difficulty, and to obviate the necessity for acquiring technical skill and accuracy. In all instances delicacy and simplicity, and to a large extent efficiency, have been sacrificed. Indeed, some of the productions are so crude and clumsy as to be mechanical curiosities.

"Realizing how apparently hopeless to many is the mastery of the technic of this appliance, I have, after many months of careful thought and experimentation, succeeded in producing another type of mechanism—that which I am about to describe, and which, while retaining much, if not all, of the force control of the pin and tube appliance, possesses other advantages, besides being far easier to apply and operate. In fact it is so simple I think you will agree with me that there is now no necessity whatever for change of principle or modification of form, even by the habitual "modifier," that well-known type of practitioner whose greatest happiness seems to consist of modification of mere details in mechanism—nearly always to the detriment of the mechanism.

"In presenting this new mechanism I fully realize the normal responsibility I must assume, or that anyone must assume when he attempts to add anything to the already very large number and variety of orthodontic appliances. If the added device be not truly useful and an advance beyond what has already been produced, better by far it should never appear, for it will not only cause unnecessary inconvenience and disappointment to many patients and orthodontists, and further add to the confusion of our literature and to the perplexity of the ever-increasing number who review it, but it will lessen confidence in its author. The usual crude modification or mere difference without distinction in principle is more often a step backward than forward, but there are reasons why, at this time, there should be additions to our orthodontic mechanism, additions that are real improvements, the wonderful advances that have been made in the science of orthodontia in the past very few years having made necessary the rearrangement of our entire plan of treatment, and demanding decided betterment in orthodontic mechanism."

ANGLE'S NEW DEVICES

"The forms of mechanism I shall now describe, if not strictly in accord with all the ideals set forth, will, I believe, upon careful analysis by competent judges, at least be found to be measurably nearer these ideals than any of the forms hitherto employed. They have not been hastily evolved, but are the result of long experience, close and careful observation, and the closest consideration of every detail as to the material of which they are composed, their size, forms, proportions and relations of parts, the mechanical principles on which they are to operate, and the physical and physiological laws that are to govern their use. At the same time the object has been to produce an appliance which will be easy to understand and so simple as to reduce to the minimum the difficulties and exactions of the technic of both its adjustments and operation. This mechanism is of course based on that excellent main principle of the expansion arch given to us long ago by that great Frenchman, *Fauchard,* whom especially all orthodontists are honored in honoring. Some of the devices are but modified forms of my own former, well-known appliance; others are radically new. All are harmoniously proportioned, refined, and very delicate."

BRACKET

"A, Fig. 38 [Fig. 9], shows a delicate block of metal, or bracket, actual size, and b and c, show it enlarged to facilitate description. All are shown attached to band material. The outer edge of the bracket is rounded, as are also

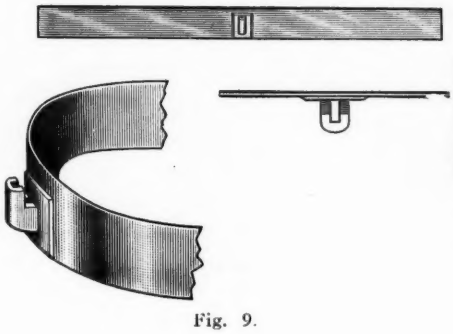


Fig. 9.

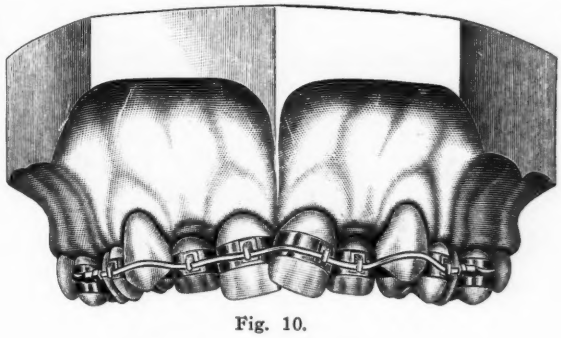


Fig. 10.

its corners and its two ends, its sides being straight and parallel. Inwardly, a deep transverse slot extends downward in the bracket one-half the length of the bracket, terminating in a concave floor. The walls of the slot are parallel, one of them being formed by the band material and the other by the inside of the bracket proper. In the center of the latter wall is a delicate square perpendicular groove which passes downward and through the floor of the bracket. Its use will be considered later. The band material to which the bracket is soldered and which forms the inner wall of the slot is thickened at this point which is very important, in order to give it the necessary strength. Fig. 39 shows several bracketed bands fitted and cemented to the crowns of the incisors of an upper dental arch typical of those, especially in Class 1, in which the teeth are crowded and the dental arches proportionately diminished in size. It will be especially noted that the seams of the bands have been formed on the lingual surfaces of the teeth, and that the brackets are located at the *center* of their labial surfaces."

"*Ribbon Expansion Arch,* is a very delicate, flat, continuous, or nonsectional, expansion arch with parallel sides and rounded edges. It has, therefore, the form of a ribbon, and in order to distinguish it from the other forms of my expansion arches, I have called it the 'ribbon' expansion arch. It is but twenty-two thousandths of an inch (.022") in thickness and thirty-six thousandths of of an inch (.036") in width. Its ends are also flat, but threaded, and are provided with my well-known friction lock nuts, which have been greatly reduced in diameter in order that they may conform to the delicate proportions of this arch, which is used in connection with the usual anchor clamp bands, the sheaths of which are also reduced in diameter and possess other novel features which will be described later. They are shown on the teeth in Fig. 39" [Fig. 10].

It will not be necessary to describe the application of this appliance, the following illustrations explain themselves.

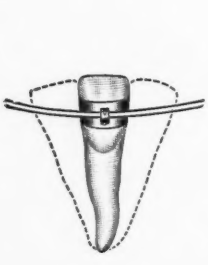


Fig. 11.

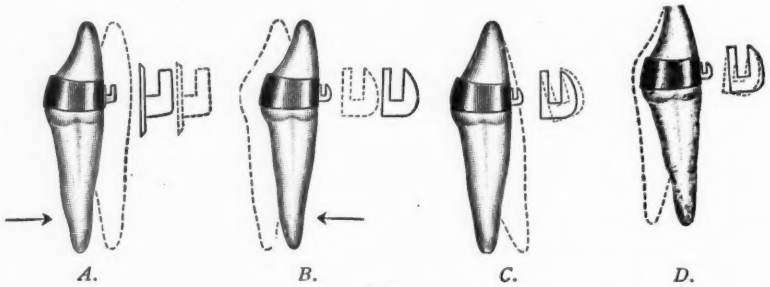


Fig. 12.

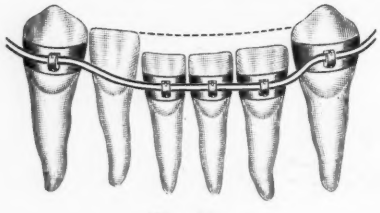


Fig. 13.

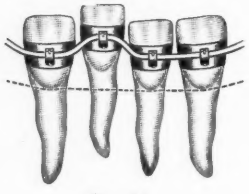


Fig. 14.

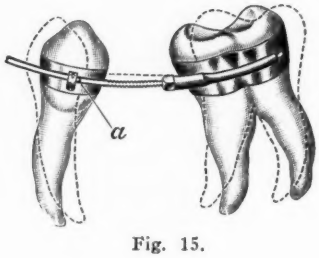


Fig. 15.

SUMMARY OF ADVANTAGES OF THE NEW DEVICES

"From the foregoing it will be apparent that the force may be so controlled as to permit or to prevent the tipping of any tooth or teeth to any extent, or to compel the bodily movement of any tooth or teeth in either or both arches.

"It will have been noted that this mechanism is of the greatest simplicity, of the maximum delicacy of parts, and with all unnecessary material eliminated. Hence it is of the least inconvenience to patients and the easiest to keep cleansed. It would seem that the mechanism is nearly ideal, not only for securing the necessary static force for anchorage and of dynamic force for tooth movement, but for directing and controlling this force so that all cellular change attendant on tooth movement most nearly accords with the laws of physiology. It is also graceful in its proportions and not unpleasing in appearance. In a word, the principles of mechanics, art, and physiology do not conflict, but are made to

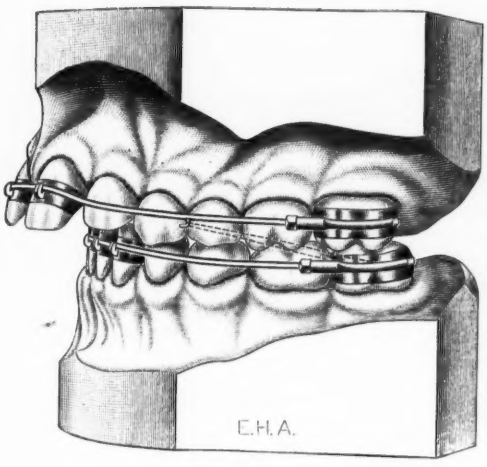


Fig. 16.

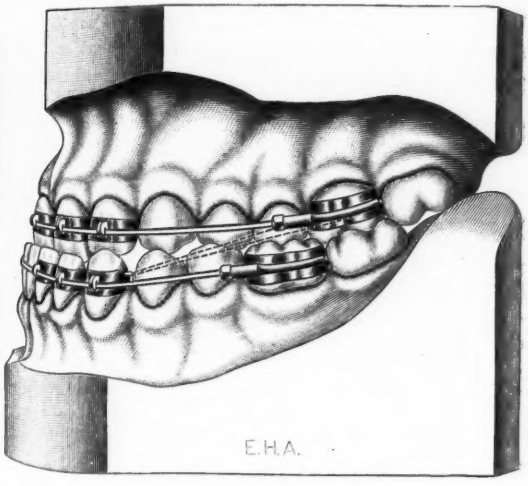


Fig 17.

Fig. 18.

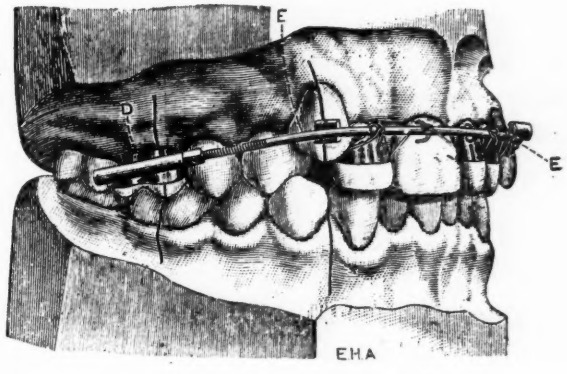


Fig. 19.

Fig. 20.

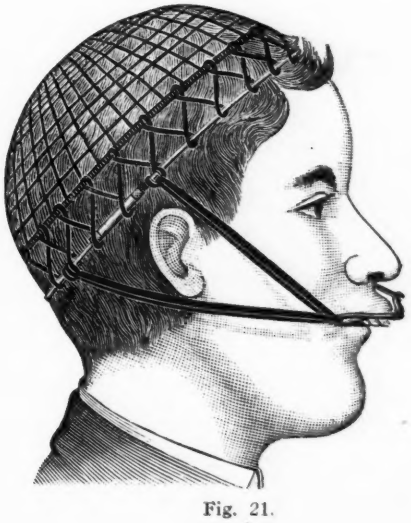


Fig. 21.

harmonize beautifully and as was never possible in orthodontic mechanism before. It is so simple and easy to apply as greatly to lessen the usual work of the orthodontist and the usual number of visits of patients. It is not expected that it will wholly supersede the pin and tube mechanism, neither will it wholly supplant the expansion arch in its round form with ligature attachments. In fact, the ligature attachment will be found to be of advantage in connection with the ribbon arch in the movement of premolars and of other teeth that may be so pronouncedly misplaced as to render impracticable the bending of the ribbon arch to gain bracket attachment with them until after they have first been moved into more favorable positions by means of ligatures. But in the great majority of cases the mechanism herein shown will be found to possess such obvious advantages in force control and in ease of application and operation, that I believe it will find a permanent place in orthodontia.

"In concluding the description of this mechanism, let me say that I have given such close care and thought to perfecting it in all its details, and have been so ably supported by the manufacturers, that I feel sure that it can not be improved by modifications or additions, at least not until you give it years of thought and study, as I have. Therefore let me earnestly advise that, instead of attempting to modify it, you devote your energies to understanding it and its possibilities, and to perfecting your skill in the technic of its application and operation. In this way your opportunities for self-improvement will be greatest, and you will be able to confer the greatest amount of good on your patients. Apt in this connection is the remark of the great surgeon, *Hamilton:*

" 'It is not in the discovery and multiplication of mechanical expedients that the surgeon of this day declares his superiority, so much as in skilful and judicious employment of those which are already invented.' "

Fig. 19 shows an old type of appliance used by Dr. Angle applied to a model. Fig. 20 shows Angle's "chin cap" and "head gear," and Fig. 21 is another illustration of Angle's "head gear."

ABSTRACT OF CURRENT LITERATURE

Covering Such Subjects as

ORTHODONTIA — ORAL SURGERY — SURGICAL ORTHODONTIA — DENTAL RADIOGRAPHY

It is the purpose of this JOURNAL to review so far as possible the most important literature as it appears in English and Foreign periodicals and to present it in abstract form. Authors are requested to send abstracts or reprints of their papers to the publishers.

Epithelioma of the Buccal Mucosa. L. Imbert. Marseille-Medical, 1919 No. 3, p. 123.

Cancer of the buccal mucosa is perhaps somewhat less frequent than cancer of the tongue, but is not very exceptional. It is of extreme malignancy, with extensive and premature glandular involvement. The primary focus remains undiscovered for a long time, it is usually situated behind the commissure, but soon spreads in the various directions offered to it, as follows: (1) Along the entire extent of the oral mucosa, especially downwards; (2) on the gums, whence it reaches one of the jaws, preferably the lower; (3) towards the skin, the tumor ulcerating neoplastic proliferation; (4) towards the glands, usually the submaxillary glands.

In the author's opinion, infiltration of the maxillary bones is relatively rare, but this may be due to his having operated on not very advanced cases; a few of these, however, had been considered as inoperable by other surgeons. The gums were not involved in these cases, so that the underlying bone could be safely regarded as intact. When doubts exist in this respect, the operator should not hesitate to perform a thorough curettage above and below. With special reference to the teeth, carious teeth are almost invariably present. While the patient could, of course, be referred to a dentist before any operative intervention, it seems preferable on the whole to do the dental extractions in the course of the operation, any surgeon being able to do this work when the buccal cavity has been so widely opened by a commissural incision. All carious teeth and stumps must naturally be removed, but the author regards it as advisable to remove all the upper or lower molars as a routine procedure. This precautionary measure guards against the frequent and practically constant recurrences, which can only be hastened by contact with the teeth, in a mouth where measures of cleanliness are necessarily difficult after the operation.

The author never had occasion to perform resections of either maxilla, and there was no reason to regret this, as recurrences were invariably noted by him in the soft parts or the glands. Extirpation of the submaxillary glands, when these are enlarged, is an indispensable supplement of the operation. Immediate

results of surgical intervention in these cases are good, and the patients recover promptly, but are exposed to a double danger in the form of constriction of the jaws and recurrence of the neoplasm. The latter may be considered as the rule, the tumor reappearing either in the preserved soft parts, or in the glands, or very frequently in both these locations together. Constriction of the jaws is likewise practically constant; even when a very large flap has been applied, the absence of mucosa on its deep aspect gives rise to adhesions which are very difficult to handle. For this purpose, the author employs the dilators in use against the constriction following war wounds, especially the wooden wedge which the patients insert themselves, morning and evening, between the jaws, and with the assistance of which they succeed in preserving a certain degree of opening the mouth.

Epithelioma of the Tongue. P. Delbet. Progres medical, 1919, No. 11, p. 105.

The patient, an elderly woman, came under observation in the Necker Hospital in Paris, complaining of a persistent ulceration of the tongue and exaggerated salivation. On examination, an irregulary outlined gangrenous ulceration was seen on the right border of the tongue; on attempting to palpate the ulcer margins, a very pronounced induration was encountered, this infiltration constituting the tumor itself. A series of neoplastic glands could be felt in the submaxillary and carotid regions, which must always be explored in similar cases. This case represents one of the most acutely dangerous, inoperable types of lingual epithelioma. Some of these tumors assume a protuberant form, the so-called cauliflower growth, which is not the most malignant type, the ulcerative form as seen in this patient being much more likely to penetrate deeply into the organism. The gravity of these epitheliomas is explained by the fact of their belonging to the variety of lobulated pavement epitheliomas which are not amenable to radiation-treatment as utilized in the treatment of neoplasms. The danger to life following operations in these cases was formerly attributed to movements of the stump which was fastened by a thread to the patient's ear, but the real cause of sudden death seems to be through reflex irritation of the superior laryngeal nerve. These patients often seek advice too late, for what is considered by them as a simple ulceration of the tongue. Six months previously, this patient could have been cured by means of a harmless operation.

Bilateral Syphilitic Parotiditis with Left-Sided Facial Paralysis. A. Lemierre. Bull. et mem. Soc. med. d. hop. de Paris, 1919, No. 18, p. 510.

Syphilis of the salivary glands is a rare disease which the author was recently enabled to observe in a soldier 22 years of age, admitted to the hospital under the diagnosis of parotid tumor. He promptly recovered under the influence of specific treatment. The trouble began two months ago, without fever or disturbance of the general condition; the left parotid gland began to swell, followed three days later by a swelling of the right parotid. The two glands continued to increase in size for a month, the enlargement being progressive, without exacerbations, or pain of any kind. At the end of this month, left-sided facial

paralysis made its appearance. The entire condition from now on remained stationary, the parotids neither increasing nor diminishing in size. A malignant tumor was suspected and the patient at this time was referred to the author, who on examination found a very pronounced swelling of both parotid glands. The face was enlarged and deformed. The left parotid was slightly larger than the right; on palpation, both glands were uniformly hard, like wood, and regular without nodules; their contours were very distinctly outlined. Pressure gave rise to no painful sensation. The tissues and coverings were normal, without edema or redness. On the left side, facial paralysis of the peripheral type was present. The eye could not be closed, and there was some epiphora. Frowning and wrinkling the forehead was weak and imperfect. The mouth was deviated toward the right side, and the patient was unable to whistle. There were no glandular swellings, no dysphagia, no trismus, no dryness of the mouth. The orifices of Steno's ducts were normal. No swelling of the submaxillary and sublingual glands was demonstrable. In view of the bilateral character of the lesion and the appearance of the parotids, the diagnosis of tumor was abandoned, in spite of the facial paralysis, in favor of parotiditis. The origin of this inflammation, however, could not be discovered by questioning or examining the patient. Exploration of the viscera, the nervous system, the skin coverings and mucous membranes, remained entirely negative. The general condition was excellent, and the patient had not lost in weight. The institution of potassium iodide treatment, in progressive doses (up to 4 grams daily) led to a remarkably prompt recovery. In less than eight weeks, no trace of the parotid swelling or facial paralysis was left; and the iodide treatment, which had been very readily tolerated, was stopped. The patient left the hospital well and has since remained in excellent condition, without recurrence of the local disturbances.

The Osteo-Periosteal Graft in the Treatment of Pseudarthrosis of the Mandible Following Gunshot Injury. C. F. Rumsey, British Dental Journal, 1919, xl, No. 19, p. 727.

It is in the cases of mandibular fracture presenting definite pseudarthrosis with loss of bone that the bone graft holds out the prospect of a cure with the best functional results. The high claims advanced on behalf of the osteoperiosteal method by the French school are confirmed by the results of bone-graft operations in nine cases in the author's personal experience. The technic adopted by him involved some small modifications from that practiced by the French, with the following particular advantages: (1) The graft fills the whole gap and not only the lower half, as so frequently happens with the other types; (2) it restores the full continuity of the mandible; (3) no foreign bodies are required for anchorage; (4) curvature of the bone is no deterrent, as the grafts are easily bent into the required shape and then wedged; (5) the operation is performed more quickly.

Description of modified technic. A crescent-shaped incision was first made with the horns upwards, the center of the incision corresponding to the area to be grafted. A skin flap was then reflected upwards and secured. The incision

was next carried down to the lower border of the bone and a large fat flap carefully dissected up from the external faces of the bony fragments. This was also secured from above. The bony fragments were then isolated, cleaned, and freshened with a chisel and the fibrous tissue removed from the interfragmentary area (the most tedious part of the operation). The next stage consisted in separating the periosteum from the inner aspect and upper border of the fragments. This latter procedure was fairly safe on account of the attenuation of the bony extremities. Two laminæ of periosteum with subjacent compact bone, of sufficient width and length to cover the gap and allowing considerable overlap, were then chiselled from the anterointernal aspect of the tibial shaft. These laminæ were of sufficient thinness to curl up somewhat after the manner of wood shavings. One was laid internal and the other external to the bony fragments, the ends being wedged under the tissues overlying the fragments. The intervening space between the grafts, corresponding to the gap, was filled in with small pieces of compact bone chiselled from the shaft of the tibia. The fat flap was then released and sutured in position over the grafts, forming a thick pad, which held the external graft in position, and finally the skin flap was brought down and sutured in position over all.

Free Transplantation of the Rib in the Treatment of Mandibular Defects. E. Redwitz. Korr. Blatt f. Schweizer Aerzte, 1919, No. 39, p. 1493.

The author discusses the question of grafting in mandibular defects, his personal observation being strongly in favor of free costal transplantation. Radiograms which were taken seven years after the operation in an illustrative case showed that the rib had healed in perfectly, as had also the wire which served for the suture. The structure of the rib was plainly demonstrable. The good cosmetic and functional result proved permanent and underwent no changes. For the substitution of the ascending ramus of the lower jaw, the metatarsus would seem to be the most suitable, in view of its configuration.

Rotation of the Cheek in the Plastic Surgery of the Face. L. Esser. Korr. Blatt f. Schweizer Aerzte, 1919, No. 39, p. 1496.

The method of facial plastics, inaugurated by the author, consists essentially in utilizing the cheek and the adjacent submaxillary and cervical regions for the plastic material required in the filling of defects and replacing of changed or cicatricial portions of the skin. This procedure guards against the disadvantage of the plastic skin-substitute being recognized even from a distance as some foreign material, as is true in grafts from the skin of the forehead or arm. In plastic work on the nose, the disfiguring frontal cicatrices are done away with. According to the situation of the defect, a curved circumferential incision is applied on the cheek at a suitable level, the incision passing at first rather horizontally, if possible in a line with the lower furrow of the eyelid as far as the ear, and from here along the posterior maxillary border to slightly below the maxillary angle. Smaller defects require proportionately smaller flaps from the cheek. The resulting skin flap, which always contains the external maxillary artery, is

now undermined to a variable extent, under preservation of the facial nerve and the mimic muscles, and is then rotated upwards and forwards. This procedure, which has long been applied in plastic surgery, is described by the author as rotation of the cheek. The method is well adapted for the plastic repair of the eyelids, cheek, nose, lower and upper lip, tissues of the same character being exclusively utilized. Very favorable results were obtained by its employment in a great variety of cases.

A Curious Ocular Syndrome of Dental Origin. H. H. Martin. Southern Medical Journal, 1919, No. 3, p. 157.

The unusual features in this case, which concerned a man of 49 years who came under observation complaining of imperfect vision and a floating opacity in the right eye were the contracted field, the sharp limitation of exudates to the anterior third of the vitreous, and the startling promptness with which all symptoms began clearing up on the removal of the supposed cause, which was clearly a dental lesion. The only focus of infection that could be demonstrated was at the apex of the right upper incisor teeth, which was inanimate as the result of removal of the pulp some years previously. This tooth was extracted and was found to contain pus, the pulp cavity being filled with a thin foul-smelling fluid with a small apical abscess. Three days later, vision in the right eye was very much improved and this improvement continued without interruption for about seven weeks, the left eye remaining entirely unaffected during this time. About two months later, precisely the same condition recurred in the same eye, and an examination revealed marked tenderness over the site of the former dental lesion, with two minute fistulous openings through the roof of the mouth just posterior to the former site of the right upper incisor. The dental lesion was exposed and thoroughly curetted; a small alveolar sequestrum was found and removed. The very next day vision had improved to 20/30, and three days after the operation the field had been extensively restored. The lesson taught by this case is that no focal infection is too insignificant to cause serious lesions in a highly sensitive vascular structure such as the eye.

Idiopathic Epilepsy Due to Empyema of Antrum of Highmore. J. C. Keeler. The Laryngoscope, 1919, xxix, No. 8, p. 484.

The etiologic factor in a case of epilepsy concerning a soldier 34 years of age was discovered to be a focal infection in the antrum of Highmore. During the past five years, the patient suffered frequent convulsions, the attacks increasing in frequency and severity. Hearing in the left ear was dimished to about one-third the normal power. His gait was staggering; he had attacks of dizziness so great that he would fall if not supported. Immediately preceding a convulsion, he experienced queer feelings in his head (aura), and he observed that after a convulsion there was a thick, light-colored, offensive discharge from the nose, which seemed to relieve the head symptoms. Examination of the nose revealed a few drops of pus over the left inferior turbinate, and transillumination showed a dark shadow of the left superior maxillary sinus. The

diagnosis of empyema of the antrum was confirmed by radiography. Irrigation of the cavity, with evacuation of offensive pus was followed by considerable improvement of the hearing and general health. Irrigation was discontinued three or four days, when he again became dizzy, his hearing again became impaired, and he was apprehensive of another convulsion. Radical interference was found necessary, and the so-called Caldwell-Luc operation was performed under ether anesthesia, recovery after which was rapid and complete.

The Relation of Diet to the Development of Children, with Special Reference to the Teeth. F. B. Talbot, Medical Clinics of North America, 1919, ii, No. 5, p. 1333.

The author points out that in studying the diet and its relation to the teeth, the role of calcium phosphate in metabolism must be understood. It must be considered from the point of view of the metabolism as a whole and of the metabolism in diseases of the bony structure, such as rickets, the commonest disease of the bones, and an affection of infancy. Rickets is the disease most often associated with delayed dentition; it is characterized by a deficiency of calcium in the skeleton. There seems to be enough evidence to conclude that certain abnormalities of digestion may so affect the absorption of calcium that rickets develops even when the food contains a sufficiency of calcium. According to a table prepared by Sherman, showing the calcium contents of the common articles of food, beef, polished rice, and bananas are extraordinarily low in calcium. The more highly refined wheat is, the less calcium does it contain. Milk, oatmeal, and beans stand out as containing large amounts of calcium, and obviously should be given in large amounts when it is desirable to feed more calcium to the body. Phosphorus is necessary as well as calcium to form skeleton and teeth; it is deposited in both structures in combination with calcium. An abundance of phosphorus in suitable forms is most readily and economically secured by the free use of milk, eggs, vegetables, and such cereal products and breadstuffs as contain at least a part of the outer layers as well as the inner portion of the grains. Plain cheese, containing all the calcium of milk, should be used much more often than is the custom in this country.

There are no drugs known that will affect the growth of teeth. Rickets is said to be affected favorably by teaspoonful doses of phosphorus and codliver oil in the proportion of 1:3000. The formation of tartar deposits on the teeth can not be explained through any principles of biologic chemistry known to the author, who emphasizes that its formation must be prevented on the basis of well-known general principles of dietetics and hygiene, both of the teeth and the body.

The Practical Use of the Dental Radiograph. Sterling V. Mead. The Dental Cosmos, 1919, xli, No. 10, p. 965.

Radiography, now one of the most important branches of dentistry, is doing more to elevate the dental profession than anything else, and the author emphasizes the great responsibility which is being placed upon dentistry by reason of the disclosures of the radiograph, a responsibility which the profession is

fast proving capable of assuming. The radiograph is a valuable diagnostic aid in dentistry when interpreted by one thoroughly schooled in dentistry and one who understands what it really shows and who knows its defects and limitations. The variegated uses of the radiograph are concisely shown in the following list:

1. To determine whether the mouth is the focus of infection, producing systemic disturbances.
2. To determine whether the teeth are the cause of reflex irritation, such as neuralgia, headaches, etc.
3. To determine whether there is apical or periodental infection.
4. To follow the course of a fistulous tract.
5. Proving root-canal fillings and locating canals.
6. To determine whether or not there is a perforation.
7. To determine condition of teeth before filling and when contemplating a restoration.
8. To determine the extent of radiolucent area.
9. As an aid in extraction of impacted teeth or unerupted teeth.
10. As an aid in locating roots, fusion of roots, etc.
11. To determine whether permanent or deciduous teeth.
12. To determine the presence of permanent teeth.
13. To determine when to extract deciduous teeth.
14. To determine whether teeth are fully formed.
15. In the practice of orthodontia.
16. To show supernumerary teeth.
17. To show pulp stones or secondary deposits encroaching upon the pulp.
18. To show excementosis.
19. Before and after apicoectomy, resection, etc.
20. To show fracture of bone.
21. To show fracture of teeth.
22. To show overhanging fillings.
23. To show ill-fitting crowns.
24. To locate hidden dental caries.
25. To show extent of periodental bone destruction in pyorrhea alveolaris.
26. In diagnosis of pathologic conditions of the maxillary sinus.
27. To locate foreign bodies.
28. To observe planted teeth.

A Protest Against the Reckless Extraction of Teeth. W. Alvarez, Journal American Medical Association, 1919, lxxiii, No. 16, p. 1179.

The author enters a protest against the exaggerated and indiscriminate removal of teeth, recommended by the radical group of dentists, and urges more conservative measures in view of the fact that the most thorough removal of focal infections often fails to cure arthritis and other diseases. Serviceable teeth should be saved whenever possible. There need be no question as to the removal of infected teeth which are loosened, perhaps hanging to wobbly bridges, or which have lost their crowns. Conditions are altogether different if the teeth

are strong and serviceable, if the areas of rarefaction are small and questionable, and particularly if restoration by bridges will be impossible. Such patients should be candidly told that the proposed extraction is more or less of an experiment. In some cases the bacteria which may originally have entered through the jaws seem to have obtained so firm a hold on the joints, the heart valves, and other tissues that they will not leave simply because their old port of entry has been closed. In other cases, irreparable damage has been done, and the joints can not return to normal even after the disappearance of the infection. It must be kept in mind, moreover, that focal infection is probably not the only case of arthritis; which in a number of cases is plainly tuberculous or gouty. The unsatisfactory outcome of reckless extraction of teeth could often have been foretold by an experienced physician, who would have warned the dentist to proceed cautiously and conservatively. Radiograms which were used in deciding which teeth were to come out have sometimes been secured by the author, and he was unable to find more than one or two roots which after years of experience he would call infected. In some, downward projections of the antrum had evidently been mistaken for abscesses. In others, it seemed to him that the physician, quite oblivious to any possible value of the teeth to their owner, must have ordered their extraction simply because he believed it a panacea for most diseases.

The Relation of Oral Sepsis to Mental Diseases. H. A. Gotton. Journal of Dental Research, 1919, i, No. 3, p. 269.

The author feels that he does not overstate the facts when he says that insanity can be prevented or cured by a conscientious practice of the principles discussed in this paper, and that, in the same way, many other diseases which in most cases have a fatal termination, can also be prevented or cured if the process has not gone too far. The fact has been recognized for years that infections and toxemia cause mental disease, and a small group of such cases has thus been diagnosed as "toxic infectious psychoses." Infection is conceded as playing an important part in the etiology of mental conditions, but its presence is often difficult to establish, because chronic infections often produce neither subjective nor objective symptoms, and are, therefore, difficult to demonstrate by the ordinary methods of examination. The possibility of curing mental diseases by eliminating infected teeth was first shown by Upson, in 1908, who reported cases of the so-called functional psychosis as both dementia precox and manic-depressive insanity, which recovered when impacted and unerupted molars were extracted, and root infections were eliminated. An active interest in the teeth of their patients, by physicians, will do much to prevent occurrence of nervous and mental diseases. Very serious trouble may originate in the teeth without being discovered, and may be allowed to progress to the point where it finally causes the death of the patient, or if not that, a condition worse than death, a life of mental darkness.

In the New Jersey State Hospital, Trenton, where very favorable reports have been obtained by means of radical extraction of all suspicious teeth, the x-ray is utilized to determine the existence of alveolar abscesses. Simple inspection by

a competent dentist often suffices to determine the existence of teeth which need to be extracted. All capped and pivot teeth are extracted, and all fixed bridgework is removed, as a precautionary measure, in the best interest of the patient. The radiogram can not always be depended upon to show infection, for it fails to reveal a type of soft granuloma, especially just below the gum where the bone tissue is not involved. Imperfectly filled teeth may also be infected and have to be removed, even if the radiogram is not decisive.

In about 25 per cent of the Trenton mental cases, the teeth alone seem to be the source of infection, and with the removal of this source, the patients rapidly recover. (In speaking of mental cases, the so-called functional group is meant, for which no definite etiology had previously been found.) In another group, about 25 per cent, both the teeth and tonsils are at fault; in a third group, about 50 per cent, the gastrointestinal tract is also involved, with either the teeth or the tonsils, or both. Infected teeth, or the bacteria concerned in this infection, have a direct and very important relation to the pernicious activity of the colon bacillus. The organism principally concerned in dental infection is a nonhemolytic streptococcus known as Streptococcus viridans. These types, which produce a chronic infection, are nonpus-producing, and therefore their presence is masked, but they are extremely toxic, and all of the important symptoms are due principally to this characteristic, especially where the nervous system is involved. The complement-fixation test of the blood for Streptococcus viridans is very valuable in doubtful cases, and could be used to advantage by the dentist to determine the necessity for extracting suspicious teeth in the absence of apparent constitutional symptoms. If the test proves positive, then all possible sources of infection should be eliminated. This method, like the Wassermann reaction, is not infallible, and will be negative in some cases in which the infection is present. The author emphasizes the importance of the complement-fixation test of the blood for the streptococcus group as a means of determining whether or not suspected teeth are causing systemic disturbance. Every suspicious tooth should be extracted before the infection has reached dangerous proportions.

Roentgen Ray Indications for Tooth Extraction. Byron C. Darling. Journal of Dental Research, 1919, i, No. 3, p. 391.

Summary of Conclusions: (1) The roentgenogram, when interpreted by the trained medical or dental roentgenologist, is one of the most dependable means of diagnosis of conditions that may indicate tooth extraction. It shows when the condition of an infected tooth is such that it means the health of the patient. (2) Tooth extraction should be more generally prescribed: at present no other method for the cure of dental abscesses can be guaranteed to remove the focus of infection that leads, or may lead, to systemic diseases. (3) The trained medical or dental roentgenologist, and not the dentist, should be the best and final interpreter of the roentgen plate in the diagnosis of tooth conditions, since the roentgenologist can have (a) neither pride of reputation in the previous dental work, (b) nor any financial interest in the future dental work, and (c) his training has been taken for the p[illegible]se of interpretation and valuation of x-ray

evidence. (4) The commercial x-ray laboratory offers unprofessional and unreliable work and service, and, therefore, should be discouraged. (5) The dentist should not attempt to do x-ray work himself, since the practice of dentistry itself is so comprehensive that it requires the whole time and energy of the dentist, allowing little or no opportunity for expert study of the technic and interpretation of roentgenology that pertain to his diagnostic survey work. (6) The admission of the professional x-ray expert, either medical or dental, as a consultant, divides the responsibility for a case among three experts, physician, dentist, and roentgenologist, with consequent obvious advantages to the patient. (7) The writer offers his graphic chart as a means of convenient and definite explanation of diseased conditions of teeth for the benefit of the physician, the dentist, and the patient.

A Contribution to the Study of Fuso-spirillary Marginal Gingivitis. D Clewer. British Dental Journal, 1919, xl, No. 20, p. 749.

In the early spring of this year, while the author in his capacity as dental officer was stationed at Charleroi, in Belgium, fully 50 per cent of cases attending him for dental treatment came on account of gingival trouble of fuso-spirillary origin. So many officers and men have been under his care lately that he has been led to endeavor to trace some abnormal condition that might be regarded as a contributory factor, and which would tend to make the soldier susceptible to this disease. This factor he believes to be a dietetic one, due to the very marked lack of antiscorbutic vitamines in the normal diet of the soldier on active service. Upon the basis of his investigations, he concludes that there is good reason for presuming that fuso-spirillary marginal gingivitis has its origin in the invasion by specific microorganisms of tissues, the vitality of which has been depraved by the comparative lack of antiscorbutic vitamines in the diet of the soldier on active service. The condition has been observed in military camps in England, but certainly not with a frequency approaching that observed in the war zone, and this is probably explained by the fact that, although the amount of vitamine was restricted there, the soldier usually had facilities for the individual purchase of fruits and salads. Further investigation may shed some much needed light on the subject, and if the condition is found to take a place among the deficiency diseases, the war diet of the soldier might be suitably modified with the object of preventing what is and must be a serious item in the sick-wastage of an army in the field.

Reflex Disturbances Originating in the Nose, Throat and Mouth. I. L. Clark. Texas State Journal of Medicine, 1919, xv, No. 6, p. 219.

Reflex disturbance from the teeth is caused by: (1) Irritation and infection of the gums. (2) Decayed teeth. (3) Impaction. (4) Mouth-breathing. (5) Faulty dental work. (6) Lack of attention of cleanliness. (7) Delayed dentition. Teeth should be inspected and cleaned every six to twelve months and fillings put in early when necessary. One of the most serious things that happen from neglect is abscess formation at the roots of the teeth, and if the focus is

not properly drained and cured in the early stage, it becomes a most difficult condition to eradicate. The author does not believe it is possible to cure an abscess at the root of a tooth if of long standing, where the sac is lined with pyogenic membrane, unless the tooth be extracted. It is possible for the patient to absorb toxic material from these blind abscesses without any local reaction, such as soreness or pain, to indicate trouble at the root of the tooth. It is very important to make use of the x-ray in these cases, in order to locate these obscure foci. Impaction and dentition are other conditions where the x-ray is of utmost value.

The following conditions can be traced to focal infection from the gums and teeth: (1) Rheumatism in all its forms. (2) Neuritis. (3) Neuralgia. (4) Insomnia. Gastrointestinal disturbance. (5) Eye disturbance. (6) Furunculosis. Decayed teeth that have not been properly prepared before fillings are put in will cause trouble sooner or later, and this applies to crowns, also. The position of wisdom teeth is often faulty, and decay is common. Failure of wisdom teeth to come through is usually due to impaction against the last molar, and this results in an involvement of the reflex nervous system. Free nasal breathing is important for the proper development of the arch.

Morbidity of the Teeth Secondary to Nutritional Disorder. Semana Medica, May 29, 1919, xxvi, No. 22.

Castilla has been making a special study of the relations between anomalies and caries in the teeth and gastrointestinal derangement. He found that children with a history of nutritional disorders frequently had abnormal teeth, the enamel was less perfect and tartar and caries were frequent. Children who seemed to have kept in good health had much more perfect teeth than those with a gastrointestinal past, especially colitis. He noted also that the intensity of the morbid changes in the teeth were always proportional to the duration and intensity of the nutritional process. These changes in the teeth were found in children of 1½ to 4 years old. In older children, apparently healthy but with these changes in the teeth, investigation of the antecedents nearly always disclosed the same causes as in the others. Removal of the tartar only transiently arrests the process.

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EDITORIALS

The Relation Between Rhinology and Orthodontics

DURING the past few years several articles and editorials have appeared in the JOURNAL dealing with the close relation which exists between rhinology and orthodontia. In this issue we are publishing a paper by Dr. E. W. Alexander, read before the Pacific Coast Society of Orthodontists, entitled "The Correlation of Rhinology and Orthodontia." We are pleased to publish such articles and believe that a great good can be done by bringing the specialties of rhinology and orthodontia closer together. We are aware that orthodontists and rhinologists sometimes hold different views regarding certain subjects, and in the paper read by Dr. Alexander, who is a rhinologist, we find statements made, which, from an orthodontic standpoint, should not pass unchallenged. If Dr. Alexander is right, he should substantiate and bring forth more facts to prove his state-

ments, because they vary from what has been found by certain men in the practice of orthodontia.

There has been much discussion about the etiology of the deflected septums and high and narrow dental arches, and whether a deflected septum can be benefited by widening the dental arch. From orthodontic observation of a large number of cases which are on record, it is proved that the widening of the dental arch associated with the deflected septum from above downward causes the septum to become entirely straight, or at least greatly improved as the result of the developmental changes of the entire maxillary bone. It is with considerable surprise that we read the statement in Dr. Alexander's paper: namely, "One can not, for instance, expect to correct a traumatic or developmental deviation of the septum, except in selected cases, by any procedure short of surgery. I imagine that if a septum is deflected by the upward growth of the maxilla, as it forms the Gothic arch, then it will after its complete ossification in its pathologic shape, associated with spur formation, etc., act as a mechanical hindrance to your efforts to widen the arch, because it will hold up the peak."

In the first place, from an orthodontic and developmental standpoint, we have no evidence that the deflected septum is produced by an upward growth of the maxilla. Regardless of how great an underdevelopment of the maxilla may be present, we find no evidence to substantiate or even suggest that the maxillary bone has ever grown upward and deflected the septum. Careful measurements made of faces, if they are made from a fixed point namely, the nasal process of the frontal bone, and external auditory canal, will show that in the development of the face, the roof of the mouth with the superior maxillary bone gradually grows downward. There is never any stage in life in which it grows upward toward the ethmoid bone. There are conditions in which the maxilla does not grow down as rapidly as it should, with the result that the nasal septum, which is mostly of cartilaginous origin, grows down to its normal length, and, meeting with resistance because of the failure of the downward growth of the superior maxillary bone, becomes deflected. The etiology of deflected septums from above downward associated with narrow dental arches is that the maxillary bone has not grown down fast enough to keep pace with the developing septum and the nasal septum has become deflected for that reason. We should like to have the doctor substantiate and bring forth evidence to prove in his cases, if he has found any, that the superior maxillary bone has grown upward; for our observation and investigation in various cases has never shown anything to suggest that condition. Neither has orthodontia found any case that was associated with the deflected septum in which the deflected septum interfered with the widening of the dental arch.

We have, however, found a great many cases in which the widening of the dental arch has produced a marked lowering of the roof of the mouth, which has allowed the deflected septum to straighten and present a much better condition. We are in no way opposed to a submucous operation on the nasal septum where the operation is indicated, but we do not agree with the theory that a submucous operation of the septum is going to assist in the widening of the superior dental arch. From an anatomic study of the articulation of the nasal

septum with the maxillary and palatal sutures, we fail to find any union which would indicate that the nasal septum would exert sufficient pressure or force to prevent the widening of the dental arch. In fact clinical observation has proved that the nasal septum where it is deflected from above downward becomes better as the dental arch is widened; and if it does not improve, the widening of the dental arch is in no way interfered with, neither is there anything that would indicate that the widening of the dental arch would have been hastened by a submucous operation before the orthodontic treatment of the case.

We realize that we can not expect the same developmental changes to occur in adults that we find in children. However, we are inclined to believe that more facts should be presented before orthodontists accept the teachings that the roof of the mouth grows upward during the period of the development of the deflected septum and that a submucous operation on the septum should be performed in all cases before the dental arch is widened. From an embryologic and anatomic standpoint, and clinical observation, we believe the orthodontic view of the case; namely, that the maxillary bone grows downward, under normal condition, followed by the same downward growth or lengthening of the septum, is correct. Secondly, if as a result of the underdevelopment, the superior maxillary bone fails to grow downward as rapidly as it should, those conditions will by no means affect the growth of the septum, but, meeting with resistance from below it will be deflected. Third, we find as result of clinical experience that when the dental arch is widened, it produces a development of the superior maxillary bone, and the roof of the mouth assumes a lower position and the deflected septum is benefited. It is because these things have been so apparent to a large number of men in the practice of orthodontics, we can not allow Dr. Alexander's statement in regard to the etiology of the deflected nasal septum and the treatment of narrow dental arch to pass as being accepted from an orthodontic standpoint.

The Section of Orthodontia and Periodontia

WHEN the National Dental Association was organized along the lines of the American Medical Association and different sections were formed for the purpose of having papers that were related grouped together, we find as a matter of record that one section was organized that included orthodontia and periodontia. It had been stated in times past that there was more or less correlation existing between the subjects of orthodontia and periodontia, and probably for that reason the two specialties were grouped together. We have editorially called attention to the interests which exist between the two subjects, but whether at the present time that relation is close enough to warrant the existence of the combined specialties in one section is a matter that will have to be proved. In fact, a number of orthodontists have asked why the two specialties were ever grouped, and what is the purpose of the section on Orthodontia and Periodontia. Not being periodontists, we do not know exactly what the plan of that specialty is in regard to the papers which they present before the section, and as orthodontists, we probably know less in regard to the matter. Some have stated that

the purpose of the section was to have papers from the two specialties which would be of interest to both groups. In fact, I think that was the object of the arrangement of the papers that were read at the first meeting of the section at Chicago. Whether or not the first meeting was a success, by the papers being of interest to both specialties, we do not know, but if that was the object at the New Orleans meeting, it was a decided failure. The papers read on orthodontia could hardly be considered as being of any interest to periodontists, which was thoroughly demonstrated by the fact that 95 per cent of the periodontists left the audience the last day at the time the papers on orthodontia were being read. However, they were perfectly justified in doing so, for on the first day of the meeting after the two orthodontic papers were read, the entire body of orthodontists, with the possible exception of two or three, left the room while the periodontic papers were being given. In other words, neither one of the societies showed enough courtesy to the other to stay in the room while the papers on the other subject were being read.

From a general review of the conduct of the members of the section, one would be forced to admit that so far as the individual practitioners of the specialties are concerned, they do not mix and do not care to listen to papers read by the other side. If that is the case, then it necessarily follows that the section, so far as giving papers which are of interest to both specialties is concerned, was an absolute failure as conducted at the New Orleans meeting. Whether this is because the papers were not of interest to the two specialties or whether it was because of the manner in which the program was arranged is difficult to say. It may have been because the two specialties will not mix, and it may be a lost effort to try to blend them. If we are forced to admit there is no correlation between the two specialties sufficiently great to encourage one specialty to listen to the papers given by the other, the next question is: What kind of papers should be given by the orthodontic portion of the section and what is supposed to be accomplished? If the orthodontic papers are to be of interest to the general practitioner and serve as a means of promoting orthodontic information, they should be selected for that purpose; but even if so selected, they would probably be a failure, because general practitioners will not attend the orthodontic section. Some may say that the papers read on orthodontia are published in the *National Dental Journal* and that the general practitioners read them; but as a matter of inquiry, we find general practitioners do not read orthodontic papers published in general dental journals. Experience has proved that the papers read before the orthodontic section are very likely to be published in the *National Dental Journal* a year or sixteen months after the paper was read, which very often results in the paper becoming ancient history and the author even forgetting that he had ever written such a paper. Again, if the papers that are read on orthodontia are not of interest to the general practitioner, they should deal with subjects in which the specialist is interested.

Papers should not be read which have been presented before other orthodontic societies and which do not contain any new ideas. They destroy the interest in the section. For instance, the majority of orthodontists who listened to the papers in the orthodontic section expressed the opinion that they would never

attend another meeting, because of the nature of the papers that were presented; namely, one of the papers dealt with the clinic which was given before the National Dental Association in the meeting at Chicago; another was a rehash of a paper dealing with the same subject that was presented before the American Society of Orthodontists at St. Louis, which had been published in several different dental journals, and with which all orthodontists were familiar, and had formed such fixed opinions that few even consented to discuss the paper. It may be said that those papers were presented for the benefit of the periodontists, but the periodontists as a whole, with the exception of a very few that were forced to stay, did not listen to the last paper.

Another paper was a presentation on regulating appliances which especially featured one that the majority of the orhodontists have already condemned or at least have formed their opinion of, and nothing in the paper was presented which would in any way make them change their minds. In fact all of the papers, except one, was a presentation of material that had been given at various times and was not even new or interesting. This left only the one paper by Dr. Casto which contained anything of particular interest to specialists, and those things that were interesting: namely, the impaction of deciduous molars, was not even mentioned in the title of the paper. All specialists of orthodontia are already convinced of the necessity of oral prophylaxis and radiography in the practice of orthodontia.

Coming back again to the original suggestion and the possible reason for the formation of the section on orthodontia and periodontia: namely, that papers should be read which were of interest to both sections, we can only say that it requires a firm conviction that he is right for a man to present a paper before the section of orthodontia and periodontia which features an appliance using a large number of bands upon the anterior teeth, considering the fact that periodontists have for a number of years accused orthodontists of producing all sorts of gingival ills to the teeth, and with causing all kinds of pathologic conditions by the use of bands upon the teeth during the treatment of malocclusion. We are aware of the fact that there are bands and "different kinds of bands," but we also know that, regardless of how beautiful a band may be fitted to a tooth, how accurately it may conform to the anatomic shape, the very nature of the tooth makes any band more or less of an irritation to the soft tissue. Even if the band does not come in contact with the soft tissue, there is the edge that is going to collect a certain amount of debris and a few million of bacteria which always remains a source of danger to the tooth for some time; it will not be properly brushed, and trouble is going to start. Therefore, from a periodontic standpoint, we should try to get away from bands, and not insult the intelligence of a periodontic audience by forcing upon them a regulating appliance that they have condemned years ago.

After the meeting of the section of orthodontia and periodontia, we interviewed considerably over half the number of orthodontists present, and all of them expressed the opinion that they thought they would never attend another meeting of that section; therefore if the section is to appeal to the orthodontic specialist, it will have to appeal by the presentation of a different group of papers

than have been presented at the last two meetings. Furthermore, if the orthodontic papers are to appeal to the periodontists, they will have to be different papers than those presented at the New Orleans meeting. Both the orthodontists and periodontists should take lessons in common courtesy, so they will not be so rude as to leave the room when the papers are being read by members of the specialty to which they do not belong. Members of each of the specialties were guilty of rudeness, and probably the greater blame belongs to the orthodontists, because at the Tuesday meeting, they walked out while the papers on periodontia were being read; and consequently it necessarily followed as a result of an inherited trait which is present in a large number of individuals, "Do Unto Others As You Are Done To," the periodontists acted on Wednesday the same as the orthodontists did on Tuesday.

The meeting of the section, from the viewpoint of an observer, also based on information which was obtained from a number of orthodontists, was a weak affair from an orthodontic standpoint. So far as the success of the section as a whole is concerned, the first question is: Can orthodontia and periodontia be linked together so as to work for the good of both specialties, the good of each other, and the dental profession in general? At the present time, we do not believe that the two specialties have enough in common to enable them to be jointly interested in a two day meeting. Then the only two other things that remain for the orthodontic section is to decide whether it is going to try to educate and interest the general profession in orthodontic matters, which also looks hopeless to us, because general practitioners will not attend an orthodontic section meeting, or whether the orthodontic section is to run for the advancement of orthodontists and the interest of the specialists. The last is going to be a difficult problem because any man who has an orthodontic subject which is of interest to the specialist will prefer to present it to a larger body, where he will have a more representative audience that is interested in orthodontia. We believe the officers of the section of orthodontia and periodontia have a very great problem before them, and the next two meetings will decide whether the section is to be a success and accomplish some good as it is now organized, or whether it will never accomplish anything.

ORTHODONTIC NEWS AND NOTES

Doctor A. LeRoy Johnson has announced the removal of his office for the exclusive practice of orthodontia from Springfield, Mass., to 19 Bay State Road, Boston, Mass.

Doctor Raymond R. McDaniel announces the opening of offices for the practice of orthodontia at 725-726 First National Bank Building, Birmingham, Alabama.

Doctor I. W. Bull announces the opening of his offices at 414 St. James Building in Jacksonville, Florida, for the exclusive practice of orthodontia.

Obituary

The death of Dr. Newell Sill Jenkins, of New Haven, Connecticut, occurred at Havre, France, the twenty-fifth day of September, 1919. The doctor was in his seventy-ninth year, and for fifty years occupied a prominent position in the dental profession, both in this country and abroad. He sailed from New York on the steamship *La France* on the eighteenth day of September, with the idea of spending the winter in Southern France, believing the climate would be beneficial to his failing health. Dr. Jenkins had a host of friends in the dental profession both here and abroad, and his death is indeed a great loss.

The editors desire to inaugurate this department in the Journal, but in order to do so must have the full support of the orthodontic profession throughout the country. We would deem it a great favor if our subscribers and readers would send in such announcements as might be of interest to the profession.

International Journal of Orthodontia and Oral Surgery

A Monthly Journal Devoted to the Science of Orthodontia, Including Surgical Orthodontia, Oral Surgery, and Dental and Oral Radiography.

(See page 751 for further information)

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